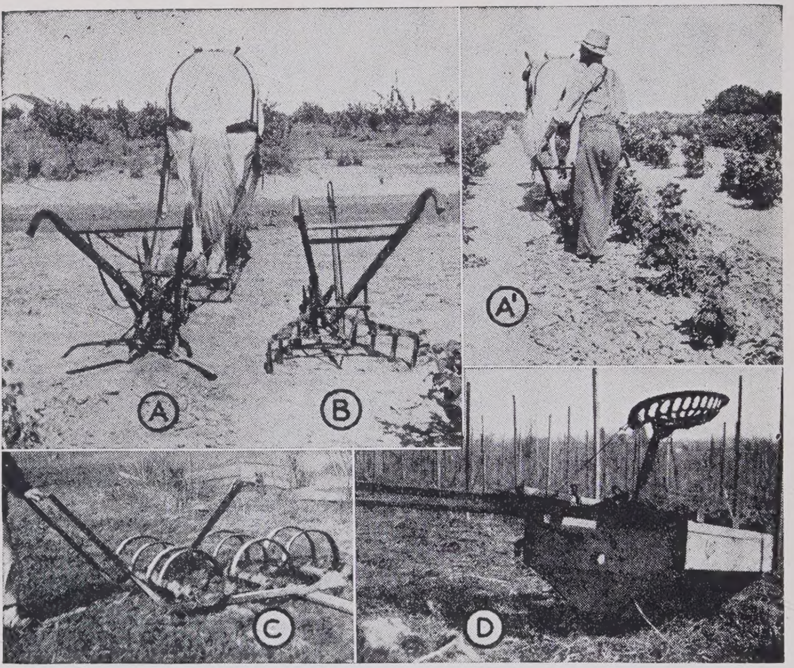
HORTICULTURE ENTERPRISES

ENTERPRISE SERIES

HORTICULTURE ENTERPRISES



Tools Used in Small Fruit Cultivation. Cultivator A, and A′, has flat blades and does not injure plant roots. Cultivator B has narrow teeth and breaks the soil after a rain. The spring-tooth harrow (C) moves soil and dislodges small weeds on rocky ground. The roller (D) firms the soil and breaks up clods. See page 219. (Illinois Station.)

Freshly Mulched Black Raspberry Plantation. Strawy manure is applied to the rows in early winter and replenished when it decays. The middles are cultivated as necessary. See page 219. (Illinois Station.)

HORTICULTURE ENTERPRISES

BY

KARY C. DAVIS, Ph.D.
LATE OF THE GEORGE PEABODY COLLEGE FOR TEACHERS

REVISED BY

WALTER B. BALCH, M.S.
FORMERLY OF KANSAS STATE AGRICULTURAL COLLEGE

A. S. COLBY, Ph.D.
UNIVERSITY OF ILLINOIS

T. J. TALBERT, A.M.
UNIVERSITY OF MISSOURI

REVISION EDITED
BY
R. W. GREGORY, Ph.D.

J. B. LIPPINCOTT COMPANY
CHICAGO PHILADELPHIA NEW YORK

PRINTED IN THE UNITED STATES OF AMERICA

FOREWORD

In 1919 the first edition of HORTICULTURE was issued. Other editions followed successively in 1922, 1925, and 1927. The foreword in these four editions said:

"TEXT-books should keep pace with the best educational thought. Too often they fail to do this; but when they do, educators may be expected to take advantage of this fact. The writer believes that the rapid establishment of high-school courses of agriculture, due in part to the federal fund from the Smith-Hughes act, has made a demand for a single text-book of horticulture suited to High and Normal Schools and Teachers' Colleges.

"**Purposes.**—It is believed that the present text, combining as it does the subject of gardening, orcharding, and small fruits, will help solve several school problems: (1) It will save the instructor much time which might otherwise be spent in trying to seek out and formulate a suitable course in Horticulture. (2) It will save the time of the class for a better balanced agricultural course instead of putting a term each on plant propagation, gardening, orcharding, and small fruits. (3) It will obviate the necessity of students purchasing three or four books to cover the horticultural field. (4) It will offer subject matter for a school year where that much time can be allowed for it, or it may easily be condensed, by omitting a few chapters and some suggested lines of work, to one-half year."

Job Analysis.—In the present volume practically all the horticultural enterprises are analyzed into jobs, and all but a few truck crops are fully analyzed into their problems. Eighteen enterprises or groups are thus analyzed.

The Analysis Plan.—In recent years teachers and supervisors of vocational agriculture have begun teaching farm enterprises through job-analysis methods. Under this plan each unit enterprise is first divided into a list of jobs or teaching units, which, when taken together, pretty thoroughly cover the entire enterprise. These jobs are arranged in the natural order of procedure in the pursuit of the enterprise or project. The list of jobs includes managerial and operative features. Some jobs include both features, while others are entirely managerial or entirely operative.

Problems.—The division of the enterprise into such jobs should more strictly be called enterprise analysis or project analysis, but when

each job is further analyzed into its problems this should be called job analysis or teaching analysis. The term as now used applies to the analysis of both the enterprise and the job.

The analysis of each job or teaching unit, as given in this book, includes: (1) a statement of the conditions under which teaching is to take place, (2) a statement of the aims or objectives to be attained in the teaching unit or job, (3) a statement of the problems for study which should be considered in the particular job, (4) a suggestion of methods or devices to be used in the pursuit of the problems by the members of the class, such as local inquiries, readings, thought discussions, field trips, laboratory work, and references to farmers and other sources.

How It Helps Students.—Such an analysis of each teaching unit constitutes a written assignment of the problems for study and investigation. It helps to avoid misunderstandings on the part of listless or inattentive students. It makes it possible for absentees more successfully to make up the assignments. It makes effective the use of the school library and the community as source materials.

Helps Busy Teachers.—Job analysis undoubtedly helps busy teachers. The usual community duties of the teacher of vocational agriculture are very great. The conscientious teacher of this subject is one of the busiest of all teachers. He is often out late at night attending community meetings, or is doing case work for farmers, or is visiting projects of students, or is conducting fairs, or is holding an evening farmer's course, or is working with part-time students, and may have little time left for studying the details of lesson assignments and analysis of the teaching units. Prepared analyses of enterprise jobs should be of great assistance to the conscientious teacher who is busy in building up the farming enterprises of his region.

Practical Aspects.—It is believed that the local inquiries and problems presented in the analyses here given will help to make every job more nearly like the real farm practice of the best farmers. Home or neighborhood studies have been assigned, so that these may be made the basis of class discussion and recitation. Local inquiries also form a good foundation for field trips and make a suitable background for studies in bulletins and reference books.

To a great extent these local studies correspond to small fruit unit surveys on the particular teaching unit or job. Reports brought back by students from their own neighborhoods regarding the points suggested in each job reflect in the classroom the actual practices and conditions prevailing among farmers.

The Job Treatment.—All of the matter in the horticulture enterprises has been rewritten to give it the job and problem approach. This

has required the addition of much new material and better arrangement of the entire content.

Using the Introduction.—The elementary treatment of Plant Life in the first twenty-five pages of the text has been very favorably received by thousands of teachers. This matter serves as an introduction to Nature's laws governing the life and growth of plants. Students who have not had similar courses will find much help from such study.

Acknowledgments.—The new matter on fourteen of the leading enterprises has been thoroughly criticised and edited by Agricultural College and Experiment Station Horticulturists. Grateful acknowledgments are extended to these and many other specialists in horticultural and agricultural education who have materially aided in the production of this volume in its present form. The bulletins of many such specialists have been freely offered, and their lessons are embodied in this text. Illustrations have been supplied by many who have used their special knowledge in producing the photographs. Credit is given the different experiment stations after the captions to the illustrations.

Thanks are especially due to Dr. A. V. Storm of the University of Minnesota, who first suggested the general plan of the text and who went over critically the contents of the book.

Mrs. K. C. Davis has made pen and ink drawings for many of the illustrations, and has read and criticised the manuscript and proof.

The Revision.—The entire text of *Horticulture Enterprises* has been gone over carefully and critically by three of the outstanding horticulturists in the United States: Professor Walter B. Balch, formerly of Kansas State College; Dr. A. S. Colby, Chief in Small Fruit Culture, University of Illinois; and Professor T. J. Talbert, Head of the Department of Horticulture, University of Missouri. The statistical data have been brought up to date, all technical information has been checked for accuracy, and where it has been found outmoded by them, it has been changed to conform to the latest scientific data available; new pictures have been added, and the suggested lists of references have been completely revised. *Horticulture Enterprises* therefore continues in the field as a leading authoritative work, invaluable to teachers and students alike in vocational agriculture.

CONTENTS

ENTERPRISE		PAGE
I	Introduction to Plant Life	1
II	Apple and Pear Enterprise	27
III	Peach, Plum, and Cherry Enterprises	109
IV	Strawberry Enterprise	155
V	Grape Enterprise	181
VI	Bush-Fruit Enterprises	207
VII	Home Vegetable Gardens	233
VIII	Tomato, Eggplant, and Pepper Enterprises	239
IX	Melon, Corn, Bean, and Okra Enterprises	269
X	Onion-Group Enterprises	293
XI	Beets and Other Root Crops	301
XII	Asparagus Enterprise	309
XIII	Rhubarb Enterprise	315
XIV	Horseradish, Sea Kale, and Artichokes Enterprise	319
XV	Celery Enterprise	323
XVI	Lettuce Enterprise	333
XVII	Cole Crop Enterprises	343
XVIII	Cooked and Salad Greens Enterprises	355
XIX	Enterprise with Garden Peas	361
XX	Woodland Enterprise	371
XXI	Improvement Enterprises	405
	Appendix	445
	Index	459

HORTICULTURE ENTERPRISES

CHAPTER I

INTRODUCTION TO PLANT LIFE

BEFORE taking up the special enterprises of gardening and fruit growing, let us make a rapid survey of the broader phases of plant life.

Importance of Plants.—All human life, and, indeed, all animal life, is dependent upon plants for sustenance. Most plants are able to obtain their nourishment from soil and air. The food thus produced is stored in the form of fruits, vegetables, and other crops, and is used for the maintenance of men and lower animals.

Without plants no animal life could long exist; for animals are not able to obtain their nourishment directly from soil and air alone.

Conditions for Plant Growth.—Because of the great value of plant growth to human life, it is quite necessary that we study carefully the needs of all plants and the special needs of all our crop plants.

The needs of plants may be grouped under six heads: (1) warmth, (2) moisture, (3) food supply, (4) air, (5) light, (6) freedom from enemies. If we are able to supply the best conditions under each of these heads we shall secure the greatest crops. The great problems of gardening and orcharding are to place the growing plants in such favorable conditions.

Warmth; Temperature.—Plants are not alike in their temperature requirements. Some grow in cold regions where snow and ice surround them. Others are found in torrid regions where frost never occurs. Wide differences are seen in the warmth required by our fruits and vegetables in the temperate zone. Lemons, oranges, certain grapes, and bananas can endure very little, if any, freezing weather, even in the dormant season. Peaches are more easily winter-killed than apples and pears. Garden peas and lettuce can endure cold, frosty weather, and do not thrive well in hot weather. Melons and beans prefer the hot weather.

Moisture.—With respect to their water-loving habits plants have been classified into three societies: (1) Xerophytes, or desert plants, such as cactus, sage brush, and mesquite. (2) Hydrophytes, or water-loving plants, as pond lily, cattail, water cress, and algæ. (3) Mesophytes, or mid-region plants, such as most of our garden, orchard, and farm plants.

The desert-loving plants have very extended root systems with which

to obtain moisture; and have limited leaf surface and very leathery covering to reduce evaporation.

Water-loving plants have much more leaf surface than root surface. Some have no true roots.

The mid-region plants differ widely in their endurance of and requirements for water. The quince, for example, has shallow roots and can be made to grow on ground that is too wet for the peach.

Plant Food Supply.—Plants of the farm, garden, and orchard secure about five per cent of their food[1] from the soil and the other ninety-five per cent from the air. Plants take mineral matter from the soil and some organic elements from the air. That taken from the soil limits or controls growth more than the other. In other words, the soil supply is more limited than the air supply. If the mineral supply is increased, the plant can take more organic elements from the air. There is practically no limit to the supply of organic elements which plants can take from the air, except that enough mineral matter must be taken from the soil to keep up the proper ratio of about one to nineteen, to suit the plant.

If a gardener increases the available plant food in the garden soil the crop, in using that food, will also use about nineteen times as much from the air—with no additional cost to the grower.

The grower's problems are (1) to keep up the supply of plant food in the soil, (2) to make it available, (3) to make the soil conditions so favorable that the plant can secure the food, (4) to keep other plants, as weeds, from robbing this food supply from the crop.

Plants Need Air.—Crop plants need only the oxygen and carbon dioxide found in all air. The legumes, such as clover, peas, and beans, also secure nitrogen either directly or indirectly from the air. Very many experiments with plants grown without a proper supply of air show conclusively that plants must have a normal supply of its components.

How Oxygen and Carbon Dioxide Are Obtained.—All the green-leaf plants breathe air into their leaves and green parts of their stems. They retain such parts of this as they may require. In daylight they retain chiefly the carbon dioxide, and a part of this is used to make starch and sugar in the cells of the leaves. The surplus oxygen is given off to the air again (Exercise I). At night the plant uses more oxygen than carbon dioxide. It then breathes off the latter into the air.

Light Requirements.—The presence of light is necessary for the making of starch and sugar in plant cells. The green color bodies called *chlorophyll* are also necessary. A green plant, growing in the sunlight, is truly a starch and sugar factory. The products of this factory are used by the plant to build up the tissues, and this is called growth. We see, then, how essential sunlight is to plant growth.

[1] Technically known as "plant nutrient elements."

Leaf Function and Structure.—The leaves may be considered as both the breathing organs and digestive organs of plants. There are numerous openings, or mouths, called *stomates*, more numerous on the under surfaces. Through these the air containing oxygen and carbon dioxide is admitted and the by-products are given off. In the daylight the chief waste is oxygen, because "food getting" exceeds the "breathing." In the darkness the chief waste is carbon dioxide, because "breathing" exceeds "food getting."

The soft cells inside the leaf are provided with many small bodies bearing green chlorophyll. This gives the green color to the leaf. The upper and lower layers of epidermis are composed of transparent cells through which the light passes readily. The cells of the layer just beneath the upper epidermis are arranged in a columnar way as shown in the figure,

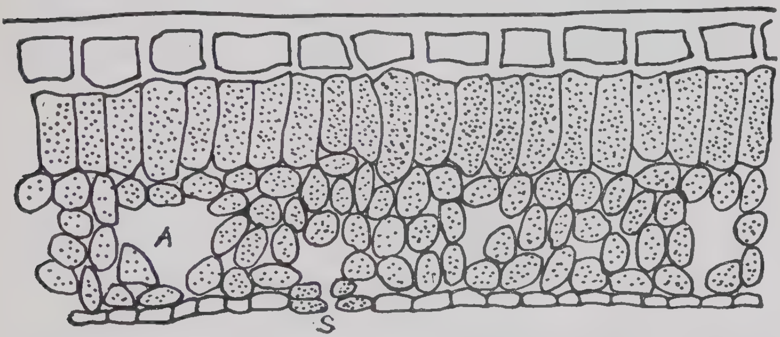


FIG. 1.—Cross section of leaf showing thick epidermis at top, palisade cells, loose parenchyma cells with air spaces, as at *A*; thin epidermis below with breathing mouth or stomate, *S*.

and are called *palisade* cells. The others are more irregular and have spaces between them for the access of air which bathes the cells. All the thin-walled cells bearing chlorophyll, inside the leaves, are called *parenchyma* cells. The essential parts of a typical leaf are shown in figure 1.

Freedom from Enemies.—Among the conditions necessary for plant growth is freedom from insect enemies, plant diseases, and weeds. For the best growth of garden and fruit crops, enemies of all kinds must be kept in check. Each of these classes of enemies is discussed in other chapters.

Germination of Seeds.—The first growth from seeds is called germination. The term "sprouting" more properly refers to breaking through the ground by this early growth. The seed contains the minute parts of the young plant. There is a store of plant food either (1) in the seed leaves, as in beans and peas, or (2) surrounding the parts of the plant, as in

morning-glory seed. This store of nourishment provides for the growth of the plant until it has developed enough to get its nourishment from the soil and air.

Best Conditions for Germination.—A proper amount of moisture is necessary to soften the seed coats and to provide for the circulation of food which the seed contains. With many kinds of seeds, such as melon, carrot, parsnip, salsify, celery, and apple, it is a very great aid to germination to soak the seeds in water for a few hours before planting. Moisture is easily brought to seeds through the soil when planted, if the soil is firmed. This may be done with the foot, hoe, or planting board. On large fields farmers do this with rollers.

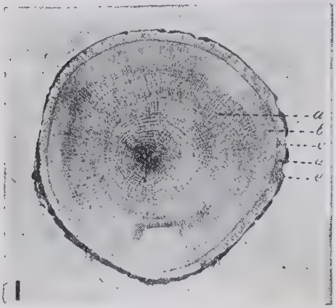


FIG. 2.—Cross section of woody stem; *a*, heart wood; *b*, sap wood; *c*, cambrium or growing layer; *d*, inner bark; *e*, outer bark.

Seeds of radish, lettuce, garden peas, onions, and other plants which endure frost well will germinate at rather low temperatures. For this reason early garden crops may be planted in early spring before the soil has become very warm.

On the other hand, such seeds as corn, bean, tomato, and melon will germinate much better if the soil is rather warm. It is partly for this reason that such crops are started late in the spring.

Air in the soil is necessary for the best germination of seeds. They will not start well in soils that are so wet as to exclude the air. A seed bed should be so well loosened by plowing or spading as to allow the free access of air. See exercise 5.

Parts of the Plant.—As the young plant grows it soon develops roots, stem, and leaves. The roots serve to hold the plant in place and to secure plant food from the soil. The stem raises the leaves up to the light and air. There are many forms of stems. See the cross-section of a woody stem in figure 2. Many vines bring their leaves up to the light by climbing on supports of various kinds Running vines extend the plant over larger areas to seek more air and light. Trees and other plants with rigid stems grow tall in competition with other plants near them. If they grow in more open places with less competition, they may become more branched, and their arms often reach horizontally a long distance into the air.

The purposes of leaves are (1) to expose the green chlorophyll of the plant to the sunlight, (2) to "breathe" carbon dioxide and oxygen, and

(3) to manufacture starch and sugar. The work of leaves has already been described.

Important Work of Roots and Root-Hairs.—The chief purpose of plant roots is to take in food from the soil. The root-hairs are far the most effective in this work. The plant food taken in by roots must be in solution in the films of soil water which cling around the grains of soil.

The root-hairs are very numerous on the smaller rootlets, particularly on the young growth. They form a velvety covering of the roots and greatly increase the absorbing surface. (Fig. 3.) It is through

FIG. 3.

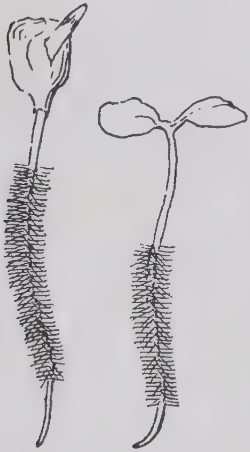


FIG. 4.

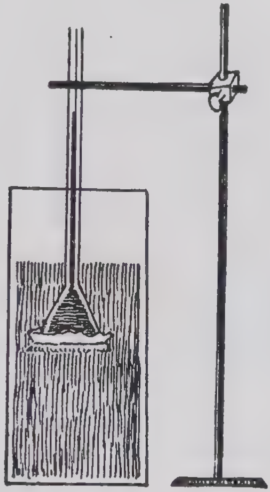


FIG. 3.—Root hairs form on all young roots except at the tip. They greatly increase the absorbing surface of the roots.

FIG. 4.—Osmosis apparatus. A funnel tube with mouth closed by an animal membrane then filled with thick syrup and suspended in water.

the root-hairs that all, or nearly all, the food from the soil is taken into the plant.

How Roots Absorb Food.—Liquids may pass through a membrane by a process called *osmosis*. When two liquids are separated by a membrane they tend to trade places and mingle with each other. The thinner liquid passes through the membrane faster than the denser liquid.

The soil water containing some plant food in solution will thus enter the plant through the root membrane. A little waste material from the cell sap will escape at the same time. This trade of the two liquids

through the surface of the root is necessary for the growth of the plant. If there be enough moisture in the soil the flow inward far exceeds the outgo, and growth will be rapid. When the soil is very dry growth is retarded, and in extreme cases the plant may actually lose as much or more than it receives. Then it will wilt and may die. Rainfall or irrigation will dilute the plant food in the soil and rapidly increase the osmotic action through the roots. Growth is thus greatly increased. **Try an exercise as described under figure 4.**

Plant Nutrients.—The plant requires a number of elements which it gets from the soil. These include nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sulfur (S), iron (Fe).

FIG. 5.—A self-sustaining aquarium, balanced with plants to supply oxygen and water animals to supply carbon dioxide.

The first four of these are most likely to become deficient in any garden or farm soil. Usually they must be replenished by the grower.

Other elements required by the plant that are taken largely from the air, as already described, are oxygen (O) and carbon (C). Really the oxygen and hydrogen are taken chiefly in the form of water (H_2O) which enters the soil from the air and is then taken up by the roots.

Evaporation from Leaves.—As the plant nutrients from the soil must be very dilute at the time it is taken in by the roots, it is evident that much surplus water is taken into the plant. This water aids in the circulation of foods in the plant. All that is not needed is evaporated from the leaves into the air. This process is called *transpiration* of water. This takes place through the little pores or stomates which are so abundant on the lower surfaces of leaves.

Importance of Leaves.—The great importance of the leaf growth on all our common leaf-bearing plants may be understood when we realize that (1) in the leaves are made the starches, sugars, and similar products for the plants, constituting about ninety-five per cent of the food of the plant; (2) it is through the leaves that the necessary breathing takes place (Fig. 5); (3) the leaves give off to the air the water no longer needed by the plant.

The increasing of leaf growth which is to accomplish all of these purposes is often the main effort of the orchardist and gardener. The use of manure and nitrogenous fertilizers aids in the leaf growth. Leaf-eating insects must be kept in control to prevent the destruction of leaves. Pruning may direct the growth in the best parts of the plant.

Bud Formation.—On all plants the leaves are formed from the un-

folding of buds. On the woody plants the buds are formed chiefly in the angles of leaves. They form on the new growth of shoots in spring and early summer, soon after the leaves of that year are well developed. They become more plump later in the year, and really prepare for winter during the last half of the summer season.

The preparation for winter of fruit trees and other woody plants usually consists of all or nearly all of the following processes: (1) Buds are formed and covered with winter scales for protection from changes of weather. (2) Hairy or waxy growth is provided to keep out water and ice. (3) In the fall the leaves drop off and the leaf scars are sealed with a corky growth. (4) The green parts of the twigs form thicker bark. (5) The breathing pores on the twigs become closed with corky growth called *lenticle spots*. (6) The buds and twigs become drier by the retreat of sap. (7) The starch and other forms of stored plant-food become fixed in the buds, pith, and elsewhere.

Two Kinds of Buds.—Nearly all woody plants, notably the fruit trees and shrubs, form two kinds of buds—one kind for the formation of flowers and fruit and another for the growth of shoots.

PROPAGATION OF PLANTS BY MEANS OF SEEDS

NEARLY all farm, garden, and orchard plants are of the seed-producing type. Other plants that do not produce seeds are represented by mushrooms, mosses, and ferns. These bear spores instead of seeds. A true seed contains the embryo of the plant which it is to produce. Spores do not contain plant embryos.

Why Seeds Are Produced.—There are several reasons for the production of seeds.

1. Seeds will live over winter better than the plants themselves. Many plants, called annuals, die in the autumn; this kind lives over winter only in the seed form. Examples of this group are corn, beans, melons, and many other farm and garden plants familiar to all.

2. Seeds are borne also for the purpose of increasing the number of plants. The number of seeds produced by a single plant is indeed surprising. If we count the number of seeds borne by one strawberry and multiply that by the number of berries on the plant in a season, we will find the product running up into many thousands. Similar results will be found with nearly all plants. Take the tomato, squash, watermelon, cucumber, blackberry, and currant as examples.

3. By bearing seeds which are easily distributed, plants provide for their spread over extended areas. With many kinds of seeds there are edible portions, as berries and other fruits and vegetables. The edible

portion induces animals to carry them away for food and thus spread the seeds. Some seeds, as carrots, parsnips, and lettuce, are carried by the wind or will float on water to distant places.

How Seeds Are Produced.—Flowers of some kind must always precede the bearing of seeds. In other words, flowers produce the seeds. The essential parts of the flower are the stamens and pistil. The seeds are borne by the pistil as a result of the pollen growth after reaching the pistil. (Fig. 6.)

Other parts of the flower are the more or less leafy growth around the stamens and pistil. These are the petals and sepals and are not found in

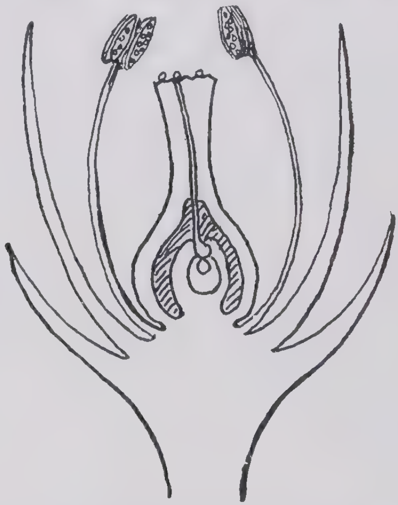


Fig. 6.—Section of perfect flower showing pistil in center with growth from pollen grain reaching the ovule. Stamens shed the pollen. Petals and sepals serve as protection and sometimes attract insects to carry pollen.

all flowers. They may serve to protect the essential parts or to attract insects.

Flowers of Several Types.—In some cases the stamens and pistils are borne in separate flowers, on the same plant, as in the cases of Indian corn, cucumbers, melons, oaks, walnuts, and many others. These are *monœcious* flowers. In other cases the two kinds of flowers are on different plants and are then called *diœcious*. Familiar examples are paper mulberry, willow, poplar, and muscadine grapes. In such cases only the pistillate plants bear seeds.

When stamens and pistils are in the same flowers, the flowers are called

perfect. (Fig. 6.) We find perfect flowers in peaches, plums, apples, pears, quinces, and the common bush fruits. Most strawberries have perfect flowers in structure but in many varieties the stamens do not develop pollen which will grow on reaching the pistils. Such varieties must have others growing near them which have good pollen.

Methods of Pollination.—When flowers have both stamens and pistils they may be self-pollinated, and this is very frequently the case.

Fig. 7.—Bees aid in pollination of fruit blossoms. A beehive was placed under this tree at blossom time, thus producing a heavy crop. (California Station.)

But there are very many varieties of orchard fruits in which the pollen does not grow well on pistils of the same variety. Thus we get better crops of fruit if several varieties of apples which blossom at the same time are grown together. This is often true of peaches, pears, and plums (Fig. 7).

There are several distinct plans in nature to prevent self-pollination even in flowers which have both essential organs. These plans are to help enforce cross-pollination.

1. The stamens may scatter their pollen before the pistil is ready to receive pollen.

2. The pistil may be mature first and may have received its pollen from another flower before the stamens in its own flower have shed any pollen.

3. In erect flowers, the stamens are sometimes lower than the pistil and the pollen does not fall readily upon the stigma of the pistil.

4. In flowers which droop, the stamens are sometimes so much longer than the pistil that the pollen falls away from the pistil instead of upon it.

Cross-Pollination.—Cross-pollination is necessary not only in the four types mentioned above, but also in the many kinds which have the stamens and pistils in separate flowers.

There is considerable cross-pollination in nearly all flowers. In many cases, as orchard fruits already mentioned, the pollen carried from one plant to another may be more likely to grow well.

How Pollen is Carried.—There are two general methods by which pollen may be carried from one flower to another, whether these be on the same plant or on different plants, viz., (1) by insects (Fig. 7) and (2) by wind. Of course pollen may be carried by hand on a soft brush. This is often done in greenhouses and where crossing of two kinds is desired.

Pollination by Insects.—When insects, such as honey bees, are in search of nectar or pollen itself, they visit many flowers of the same kind and carry pollen from one to another. The pollen on their bodies and appendages is rubbed against the stigma of the pistil and the cross-pollination is complete.

Flowers which insects like to visit have (1) sticky or heavy pollen, (2) are showy by having colored sepals or petals, or (3) bear nectar, and (4) are often fragrant. Usually all four of these characters are found in flowers pollinated by insects. Common fruit blossoms are nearly all examples of this type of flower.

Pollination by Wind.—When the pollen is to be carried by the wind it becomes dry and powdery and is comparatively light. The flowers have no need for being showy and no nectar or fragrance is found. Nuts, corn, grasses, some small grains, plantain, and many weeds are examples of flowers pollinated by wind.

Underground Pollination.—There are a few plants, as the violet, which bear two kinds of perfect flowers, the showy flowers which we commonly see in the spring and others borne under the ground later in the season. The latter are small, closed buds and pollination takes place within them. Later the seed pods of the violet project above ground in order to spread the seed (Fig. 8). Other plants which bear this type of

hidden flower are the hog-peanut, dalibarda, and fringed wintergreen. Such flowers are called *cleistogamous*, meaning hidden-union. In such cases nature enforces self-pollination.

Underground Seeds.—Most seeds are borne in the air, but the peanut is a common exception to this rule. In this plant the showy flowers are staminate and are borne well up on the stems. Nearer the ground there are small pistillate flowers. After the pollen growth has fertilized these small flowers, the flower stem elongates and they are thrust down into the ground, where the pods and seeds will mature.

Growth of Seeds.—After pollen grows in the pistil the union with the young seed cells (ovules) is called *fertilization*. Rapid development

FIG. 8.—Cleistogamous or hidden blossoms at the base of a violet clump. (U. S. D. A.)

of the seeds then takes place. It is a rather brief period from the time of this fertilization until the seeds are of full size. The garden pea develops seeds in a few days or a few weeks after blossoming. In the bush fruits this growth is rapid. Winter varieties of apples require nearly the whole season.

While the plant is developing the seed crop, much attention must be given it. Good tillage and plenty of available plant food are both desirable. It is a critical time in the life of the plant, and many crops of fruit and seeds are reduced by improper conditions during this time.

Store of Nourishment in Seeds.—The plant stores up a considerable amount of nourishment in its seed crop. This explains why the maturing of seeds is so devitalizing to the plant.

The food stored in seeds sustains the life of the young plant until it is able to obtain nourishment through its roots and leaves. It is because of this store of nourishment that we use seeds of so many kinds for human food and for stock feed.

SAVING GARDEN SEEDS

Gardeners, both young and old, should save garden seeds more systematically. In many cases much better results can be obtained if we save seeds from our own gardens.

Seed Selection.—In deciding just what seeds to save some attention must be given to the points desired in the crops. With many varieties of corn, tomatoes, beans, peas, and others, earliness is very desirable. Mark those plants which mature the crop in least time and save seed from those. Other qualities in tomatoes are proportion of flesh to seed pulp, smoothness of surface, color of fruits, and resistance to disease.

In all crops choose seeds from the best plants where but one variety of each kind is grown, and the next crop will be much improved.

Securing the Seed Crop.—When the gardener has decided what specimens are best for seeds he may mark them by tying strips of white cloth to the stems where they are growing. If the fruits are pulpy, as tomatoes, watermelons, squash, and cucumbers, the seeds may be easily washed from the pulp in a pan of water. The use of a sieve or strainer will help. When clean, spread the seeds out on papers in a sunny place until dry. Then put them into envelopes or pockets of folded paper. Properly label each lot and make such memoranda notes as desired.

Dry seeds, such as corn, radish, lettuce, and onions, may be put into their envelopes right from the garden.

Storing Seeds.—Suitable places for storing seeds may be found in every home. They must be sealed in envelopes or boxes, or these containers may be put into cans or jars with tightly fitting covers. This will keep out weevils, moths, and mice.

They should be stored in a dry, well-ventilated place. Near a chimney in a second-story room may be best. After all surplus moisture has dried away, freezing does not hurt them.

Infested with Pests.—When seeds or stored products become infested with weevils, moths, or similar pests, they should be treated very early with carbon bisulfid. Put the seeds into a vessel that can be tightly closed. Set a small open dish containing the liquid in the top of the seed chamber and close it quickly. Use one teaspoonful to a space of two gallons or less. Or use one pint to about one thousand cubic feet. Keep the container closed for several hours, say over night. The

liquid evaporates and penetrates all the space, killing every living insect. The eggs may hatch afterward and a second treatment may be necessary. This may be done about two weeks later. Have no flame near when the treatment is started, as the carbon bisulfid is very inflammable.

Seed Sources in America.—Many of the vegetable seeds of the temperate zone are grown under contract on farms in regions where the same crops are grown for market purposes; as tomatoes in New Jersey, New York, and Michigan and okra in Georgia, Alabama, and Mississippi, and other southern states. The difficulty of securing good seeds for market

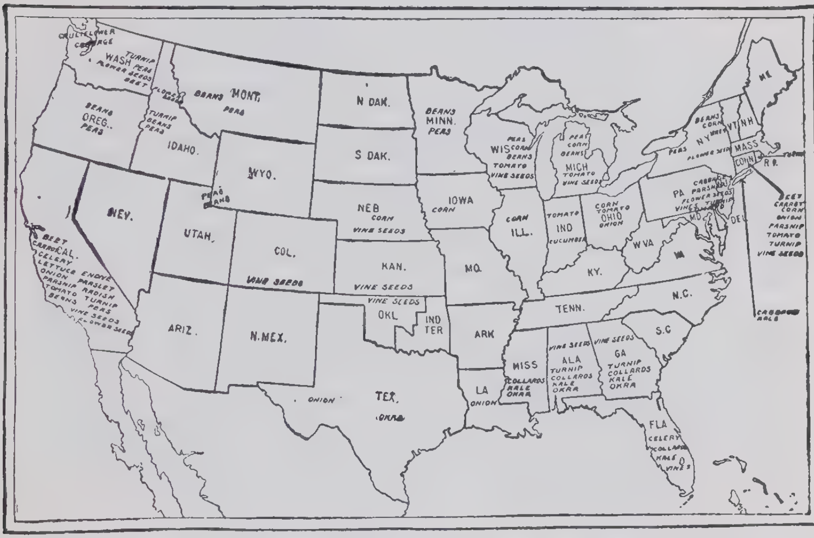


FIG. 9.—Chief sources of vegetable and flower seeds of the United States. (U. S. D. A)

is greatly increased for biennials, such as cabbage, cauliflower, sugar beets, and garden beets. While much seed of this class came from France, the world war made it necessary to change the source of supply. California came to produce more beet, onion, cauliflower, and cabbage seeds than before. Study closely the map, figure 9.

Trial Grounds for Seeds.—Many large seed companies maintain trial grounds for seeds (Fig. 10). Three main purposes are in view. (1) To select and breed new varieties. (2) To establish firmly and fix the most promising varieties before offering them to the public. (3) To test the uniformity and stability of new varieties that are offered by other growers.

Buying Seeds.—It usually pays to study garden seed catalogs carefully. Much may be learned by such study. Some catalogs are too high in their praises of new varieties. In some cases these are old varieties under new names. In other cases they prove to be very similar to old varieties. "Be not the first by whom the new is tried." Try to select the variety that will suit your purpose, your soil, and your market. If yellow sweet corn is grown for a market demanding white corn, a great mistake is made. Some markets demand pink-fleshed tomatoes and will

Fig. 10.—Seed companies test many of their seeds, particularly new varieties, before they are offered to the trade. (U. S. D. A.)

hardly take the yellower ones. Do not plant the large-seeded limas if the small prolific varieties are preferred. Early varieties of potatoes should seldom be grown for winter use; others keep better.

In selecting garden seeds consider earliness, productivity, freedom from disease, endurance of heat or cold weather, freedom from waste in using the product, popularity, and eating and keeping qualities.

Longevity of Seeds.—Old seeds are always less desirable than the fresh stock. Many kinds of seeds deteriorate rapidly with each year of age. Those kinds containing considerable oil in the storage matter are believed to endure less than others. If they are kept in very dry places the seeds will last much longer.

Detecting Age of Seeds.—Old seeds may often be detected by their dull color or faded appearance. To overcome this appearance old seeds are sometimes polished or bleached or are mixed with fresh seeds.

Testing Seeds.—Probably the best way of detecting the value of seeds is to test their power of germination. If ninety or more out of a hundred will germinate well they may be used for planting. This indicates maturity, good storage, freshness.

Simple Testers.—It is usually not necessary to purchase any apparatus for seed testing, either at home or at school. A rag-doll tester, made of a piece of cloth, is one of the most satisfactory. (Fig. 11).

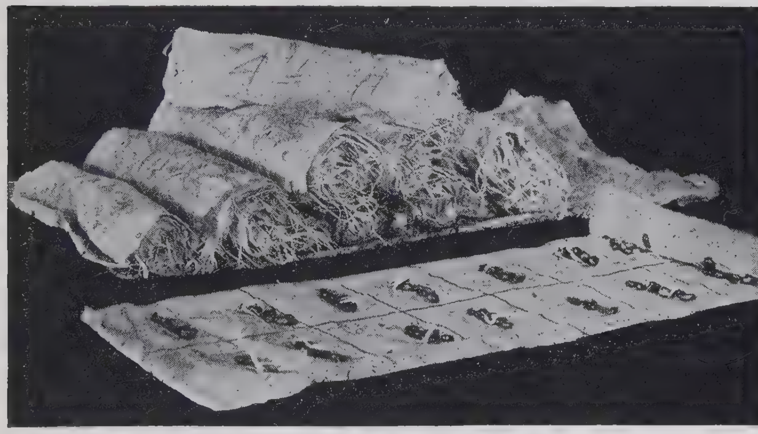


FIG. 11.—Rag-doll method of testing seed corn. Each roll of cloth contains the sample kernels from about twenty or thirty acres. The open cloth shows the variations in germination. (Photo from Iowa Experiment Station.)

Mark the cloth with a soft lead pencil into areas about three or four inches square. On each square mark a number and place a sample of the seeds to be tested. Use 25 each for large seeds, and 100 each for small seeds. Fold in the sides of the cloth. Then roll it up on a small stick the size of a pencil, and tie the roll. Slip out the stick to admit plenty of air. Soak it for an hour or two. Then allow the surplus water to drain off and keep it covered to hold the moisture, for a week or so. Examine by unrolling so carefully as to not displace the seeds from their own squares. Count how many sprout well and determine the percentage.

Testing may be done by keeping the seeds moist on blotters between plates or pie-pans. They may also be sprouted in boxes of moist sand or soil.

Seed Analysis.—There are three purposes of seed analysis: (1) to

detect the presence of good seeds of other kinds which may be mixed with them; (2) to determine the kinds and percentages of weed seeds present; (3) to determine the amount of inert or dead matter present, such as chips, pulp, gravel, dirt, etc.

Detecting Impurities in Seed Samples.—Count out or weigh out a fair sample of the seeds after thoroughly mixing the mass of seeds together. The sample should be examined by use of a hand lens. (Fig. 12.) The seeds may be placed on a piece of white paper in a very light place. With a wet pencil point pick up and sort them into a number of piles: (1) good seeds; (2) shriveled or small seeds; (3) foreign good seeds of several kinds; (4) inert matter; (5) weed seeds in as many places as

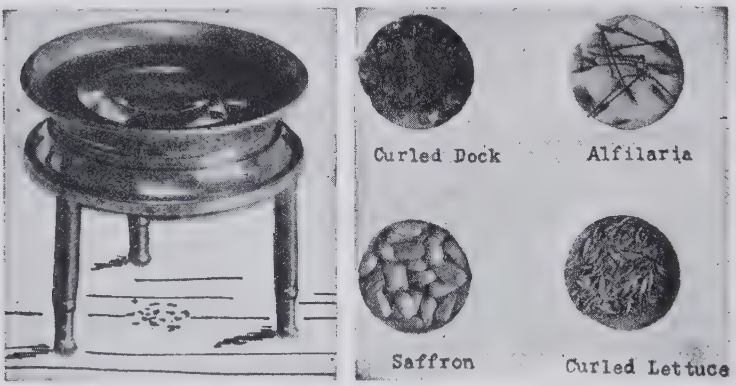


Fig. 12.—Such a lens will aid in detecting weed seeds before planting. Four kinds of weed seeds are shown at the right, mounted in holes of heavy pulp board.

there are kinds. Then by count or by weight determine the percentage of each of those in the whole sample.

Buying Seeds by Sample.—If possible a sample of seeds should be examined and tested before a quantity of them is purchased.

State Analysis.—Many states now have laws requiring all or many common seeds to be sold only after they have been analyzed by the dealer or by the state laboratories. A guarantee of quality then goes with the seeds. If they fail to reach the standard the buyer is protected by the dealer. Where such laws are in operation the examination of samples before purchase by the grower is not so necessary.

Seed Treatment.—The best materials for treatment of seeds are organic compounds of mercury, sold under several trade names. The chief one used in trials is Semesan, containing 35 per cent of mercury chlor-phenol-sulfate. This may be used as liquid or as dust. Others

tested were Bayer Dipdust, Uspulum 30 per cent (liquid only), and Semesan Jr., 10 per cent (dust only). Bichloride of mercury is the cheapest and often the best.

A number of vegetable crops have been tested at the Geneva, New York, Station (Bul. 554) and elsewhere. The treatment of seeds aids greatly in controlling seed-borne diseases and, in some cases, soil-borne diseases. Some surprising results were increased percentages of germination of all vegetable seeds tried except lettuce and spinach. The greatest increases occur with early plantings, when soil conditions are favorable for disease development. When soils are warm and germination is naturally rapid, treatment does not appear to increase the percentage of germination, but it is still recommended to control seed-borne diseases. These new materials are apparently much preferable to formaldehyde, corrosive sublimate, and copper sulfate.

Experiment stations have shown the advantages of treating not only seeds of corn, small grains, sorghums, and beets and other root crops, but also seeds of vegetables of many kinds, such as beans, peas, melons, cucumbers, radish, cabbage, tomatoes, celery, and onions.

Treatment with Semesan in a ¼-per-cent water solution is administered as follows: spinach, radish, lettuce, cabbage,—one hour; tomato, celery, cucumber, melons,—one-half hour. Any directions given on packages should be followed, however, for the times of treatment vary somewhat with the strengths of solutions. Most field seeds are probably not injured by treatment for one hour.

PRINCIPLES OF PLANT BREEDING AND THEIR APPLICATIONS IN GARDEN AND ORCHARD.

Aims.—Students should understand the simple laws of nature which govern variation among plants; laws of heredity; influencing factors; prepotency; value of selection; effects of crossing; fixation of types; value of pedigrees; and the value of cleaning and weighing seed.

By plant breeding is meant the systematic raising or reproduction of plants either with or without an aim toward improvement. When gardeners or orchardists observe certain individuals or types with characteristics which should be perpetuated, they may select these individual plants for breeding purposes. The points observed will probably be more or less noticeable in the offspring.

Causes of Variation.—It is said that no two plants are exactly alike. There is constant variation in nature between individuals even of the same kind. These differences may or may not be noticeable to the grower. This tendency to vary from each other makes it possible

for the plant breeder to select characteristics which he desires. This gives rise to new varieties and new strains. Careful observation is required to select the desired types. It is necessary to keep these ideals constantly in mind in establishing new varieties.

Among the causes which tend to make plants vary may be mentioned (1) shade and sunlight, (2) differences in soil and variation in plant food, (3) proximity of other plants, that is, crowding or the reverse, (4) weather and climate. Dandelions growing in dense high grass will grow tall; those growing in closely mowed quarters blossom near the ground. Many variations occur in nature which cannot be explained by any of these causes.

Survival of the Like and Unlike.—Heredity is one of the most important factors for the plant breeder to study. This is the law, that all creatures inherit from their ancestors certain forms, characteristics, and qualities. The law of heredity may be expressed briefly by saying that usually "like produces like."

Heredity and natural variations are the two fundamental factors which, when placed in the hands of the skilful breeder, will attain wonderful results. Varieties without end are formed, and yet these become so well established that the grower can confidently depend upon their reproduction in garden, orchard, or farm work.

If "like produces like" were an absolute law, there would be no possibility of change and all our plants would be alike. The environments of the plants set up variations, and we may find that plants which are unlike are descendants from the same parents. These various forms may suit the different environments into which they fall, and the result is a survival of the unlike. Take the muscadine grape, for example. We find in nature numerous varieties, all apparently traceable to the same common parentage. By the aid of men, the varieties found among all garden and orchard plants are greatly improved and their characteristics fixed more firmly.

Extreme or Sudden Variation.—*Mutation* is a name given to any extreme or sudden variation from a type which we have been growing. The term *sports* is sometimes applied to these sudden variations. It is fairly well established by De Vries and others that the characteristics shown by mutations may be inherited by their offspring. Bud sports of some citrus fruits and of apples are becoming of great importance in the industry.

Reversion.—Any tendency of the plants of a new generation to assume forms differing from their parents but resembling generations farther back is called reversion. If variations are established by propagating mutants—those with sudden variations—it is common to notice certain individuals in the line reverting to the old type from which the

sudden variation sprang. The plant breeder may find it necessary to throw out all individuals showing this tendency to revert to the old forms. He must keep clearly in mind his ideal and select those individuals which show a strong tendency in that direction.

Influence of Soil and Surroundings.—The environment of plants has a strong influence upon their manifest characteristics. When the plant breeder is making his selection, he must note carefully the surrounding influences. Plants adapt themselves to their surroundings. Plants of the same origin grown in different soils may show very different results. Fertilizer and tillage should be uniform in all plant breeding plots.

It is believed by some scientists that the differences due to surroundings may be inherited by the offspring. The practices of some plant breeders are based upon this belief.

Power to Impress Characteristics.—*Prepotency* is the term given to the power of plants to project or impress their own characters

FIG. 13.—Two piles at left are the first and second grades of crop from good seed potatoes. Those at the right are from poor seed.

upon their offspring. Some individuals fail to mark their offspring with their own individuality. Others have this power in a marked degree. When two parents are used which differ in certain respects, one or the other must dominate in fixing their differences upon the offspring. The characters which prevail are called *dominant* characters; those which are overshadowed are called *recessive* characters.

Breeders will naturally find it advisable to breed from those individuals exhibiting strong prepotent qualities of the desired type.

Careful Selection.—The plant breeder will find it necessary to destroy hundreds and thousands of individuals in the selection of a few which meet his ideals. Special skill is required to do this. He must observe the many ways in which the individuals vary. He must weigh in his mind the practical points and the fanciful points. It is necessary for him to choose among these and retain those most desired. Such elimination of plants not true to type is called *roguing*. An effort to hasten the improvement of plants is exercising the powers given man by the Creator. This is an argument in favor of artificial selection (Fig. 13).

In nature, selection seems to be careless. The power of man's mind adds greatly to the improvement of plants and the establishment of varieties which yield infinitely better products than those found in nature. The importance of seed selection is shown in figure 14.

The breeder must know the history of the type which he is trying to develop. He should keep the practical or economic aspect strongly before him. The laws of variation and heredity must be strongly in his mind.

FIG. 14.—Relative sizes of radishes grown from small and large seed.

Hybrids.—New forms are often created by crossing rather distinct forms, such as species. Pollen taken from one variety of apples and crossed on other varieties produces seeds which may result in hybrid trees. A Japanese plum of one variety may be crossed with a variety of European plum or American plum. The resulting offspring would be a hybrid. This method of producing new varieties of plants is quite commonly practiced by breeders.

The process of cross-pollination is quite simple. Anthers may be collected before they open and allowed to discharge their pollen in a shallow dish, to be used later. In other cases, a soft camel's hair brush is rubbed

on the stamens to secure the pollen. This may be dusted into a small vial and properly labeled. Before the pollen is carried to the plant bearing the pistils, the flowers must be emasculated; that is, the stamens should be clipped out with a pair of fine-pointed scissors before the pollen is shed on the pistil. The new pollen from the vial or other container is then dusted on the pistil with the soft brush. Paper bags tied over the flowers until the flowers wither will keep away foreign pollen which might otherwise be brought by bees and wind.

Mendel's Law of Fixation of Type.—When plants of different types have been used in plant breeding to form new types or varieties, the offspring will continue to vary in their characteristics and several generations will be required reasonably to fix the new type. Mendel formulated a law governing the rapidity with which plants tend to become fixed in their characters after the original crossing. If we consider one pair of characteristics, for example, wrinkledness and smoothness of garden peas, we find that in the first generation the seeds are all smooth but in the next one-fourth of the individuals will be pure wrinkled peas; another fourth will be pure smooth peas; the other two-fourths will bear the dominant characteristics of smoothness, but these two-fourths will really be mixed.

In the next generation of those which are mixed one-fourth will come as pure wrinkled, one-fourth as pure smooth, and two-fourths as mixed but having the dominant character of smoothness. The student will see that it will take many generations to eliminate entirely the mixed elements if this law continues to hold good for many generations.

Results of Mendel's Law.—It is readily seen that by the law there will always be an element which is mixed and which will never come true to the original type or to either of the pair of characteristics under consideration. If yellow and pink tomatoes are crossed, there will always be a number of individuals showing one or the other of the parent characteristics. We should expect never to be able to establish pure seed after crossing.

It is because of this law in nature that fruit growers abandon the propagation by means of seed of apples, pears, peaches, plums, and other orchard fruits. Other methods of propagation are described in the next chapter. When plants are propagated by buds, they come more nearly true to the original form and variation is eliminated.

Limits of Mendel's Law.—Plant breeders at the experiment stations in the different states and elsewhere have conducted trials, many of which vindicate the truth of Mendel's law.

The usefulness of the law, however, is limited because of the fact that

it recognizes only one pair of characters at a time. In corn breeding, for example, one dominant character and the recessive character corresponding to it are all that can well be considered at a time in the numerical formulas of this law. Yellow corn is dominant over white corn. While we are trying to select a pure type after crossing corn of two different colors, we are certain to lose sight of some of the other characters which are perhaps more important.

Many Pairs of Characters to be Considered.—If we continue the illustration of breeding, we will see that there are numbers of pairs of characters to be borne in mind by the grower who is trying to improve the strain of corn. Some of these may be mentioned here: white and pink cobs; long and short ears; large and small cobs; deep kernels and shallow kernels; ears high on the stalk or low on the stalk; many ears and few ears on the stalk; abundant suckering and little suckering; large stems and slender stems supporting the ears; early maturity and late maturity; ear protruding beyond the shucks or well covered with the shucks.

In the breeding of any plant we will find numerous pairs of characters, one of which is always dominant over the other. In deciding what pairs of characters to use or to keep uppermost in plant selection, the breeder should determine which are most practical or useful to man.

Pedigreed Seed.—Gardeners saving seed from their own plants know the history of those plants better than when seeds are purchased elsewhere. If plants of one variety, tomatoes for example, are grown in the home garden, the grower knows that there have been no tendencies to cross with other varieties. The seed is perhaps purer than any he could buy from the neighbors or growers where several varieties are produced. The term "pedigreed seed" simply means that the producer of the seed has knowledge of the parents, grandparents, etc.

Need of Attention to Improvements.—It is important that the grower as well as the plant breeder should give attention to the improvement of plants. Too often we allow good varieties to deteriorate because of little attention to improvement. Selection should be practiced constantly, not merely for a generation or two. The gardener can easily watch for favorable mutations and variations which if used will greatly improve the strain or help to establish better ones.

For example, we often find individual plants in a variety of strawberries which far surpass those about them. The berries may be earlier, larger, sweeter; the plants may be more prolific, less subject to drouth. Plants formed by runners from these may be used to start new beds with very satisfactory results.

Size and Weight of Seed.—If several samples of garden seeds are sorted by means of sieves into different sizes, it will be found that the

largest seeds will give best results. With grains which are usually weighed instead of measured when purchased, it has been found that those which weigh heaviest for the measured bushel are most productive.

The lesson to be learned here is that we should select the heaviest and best seeds when saving or buying seeds to plant in our home gardens.

Sifting and Weighing.—It pays to sift seeds through sieves which will separate the large seeds from the small. Not only will the best seeds be thus obtained for planting but many weed seeds may be eliminated. When grass and clover seeds are to be sown in the home grounds, they should be carefully sifted and weighed to determine the proportion of seed and chaff. Light seeds may be blown out by means of the fanning mill or other forms of seed cleaners.

Seed Associations.—In many states there are associations formed to encourage the production of better seed. Conditions and standards are formulated. Growers who meet these conditions in the production of pure-bred seed are given certificates of standard. These certificates serve as guarantees of purity and quality, and aid buyers in procuring the best.

FIELD AND LABORATORY EXERCISES

1. **Oxygen from Plants.**—In a glass jar of water let a large supply of algæ or other water plants be placed for growth. Over the plants invert a glass funnel and test tube or bottle in a manner to catch the oxygen given off by the plants. Place the jar in a sunny place for a few hours and test for the presence of oxygen in the bottle by the use of a glowing splinter. What has been taking place?

2. **Disappearance of Chlorophyll.**—Place a board over some green grass so as to exclude the light for a few days. Then note the change in color of the grass. Will crops growing in shaded places make as much growth as those in the light? Name some plants that endure shade well.

3. **Effect of Available Plant Food.**—Compare growth of plants of the same kinds on poor soils and rich soils. What are the chief differences? From which would you prefer to save seeds?

4. **Structure of Leaves.**—If a strong microscope is available, mount in water on a glass slip a piece of epidermis torn from a leaf. Try several kinds. Study the stomates and the chlorophyll-bearing cells. Also make cross-sections by placing the leaf between two pieces of pith and cutting with a razor. Thin sections will show under the microscope somewhat as shown in figure 1.

5. **Exercises in germination** may be devised to show the best conditions for seed growth. After reading the conditions in this chapter, try them by germinating seeds under as many conditions as you can find to show the effects of proper moisture, warmth, and air.

6. **Osmosis.**—Try some experiments to show osmotic action. (1) Arrange an apparatus as shown in figure 4. Have water in the large glass and a strong

sugar syrup in the funnel tube. The membrane tied closely over the funnel mouth may be from a bladder or from a large intestine used over a piece of sausage. The funnel tube may be extended to any height desired by connecting more glass tubing through short pieces of rubber tubing. (2) An exercise with egg osmosis is described in science books. Repeat this. (3) Soak a withered potato or apple in water and explain the results. Soak a fresh apple in strong syrup and explain why it shrivels.

7. **Nitrogen in Air.**—Invert a glass jar full of air, with the mouth immersed in a vessel of water over which is floating a large cork supporting a small burning candle. The candle will continue to burn for a short time in the jar of air and the water will slowly rise in the jar. When the flame goes out because of the exhaustion of the oxygen, calculate what fraction of the air still remains. This is chiefly nitrogen. After the fumes dissolve in the water study the color and other properties of the nitrogen.

8. **Properties of phosphorus and potassium** should be studied by following directions given in some elementary book on chemistry.

9. **A collection of fertilizer materials** should be made by getting samples from dealers. Study these as to appearance, composition, and other properties Put the samples in bottles and label plainly.

10. **Leaf Structure.**—If a compound microscope is available let each student study the structure of leaves by making sections and mounting them in water on glass slips. Surface views should also be mounted to study the stomates.

11. **Bud formation on fruit trees** should be observed during the spring season while the leaves and shoots are growing. How soon can you detect the new buds for the following year? Why are they formed so early?

12. **Preparation for Winter.**—Try to find on trees all the seven methods mentioned in this chapter by which the tree prepares for winter.

13. **Methods of pollination** should be studied in the apple, peach, plum or cherry, and in the bush fruits. Also study the wild rose blossom as to the relation of stamens and pistil. Make similar studies with peas, sweet peas, beans, cucumber, tomato, okra, and all blossoming plants in the garden. What ones seem to have plans to prevent self-pollination?

14. **Pollination by Insects.**—Make a list of vegetables, fruits, ornamental flowers, and weeds that are visited during the flowering stage by insects. Which ones have nectar or are fragrant? Which ones attract insects by their color only? Mark those that have sticky, heaven pollen.

15. **Seed formation** should be studied when blossoms are dropping their petals and losing their bright colors. Examine common vegetables and fruits during this stage, and a little later as the seeds or fruits are developing.

16. **Choice of Seeds.**—Practise the selection of seeds in the garden. Compare plants from which seeds are to be saved with others in the garden. Bear in mind earliness, quality, smoothness, or other market characteristics, abundance, resistance to disease, etc.

17. **Contest in Seed Saving.**—Students may enter a contest to see which ones can save the largest variety of garden seeds (1) from their home gardens,

(2) from the whole community. Compete for first, second, and third places in the contest. Get enough of each kind to plant a small home garden.

18. **Identify impurities** found in the samples, and calculate losses if seeds were used having these impurities.

19. **Seed Survey.**—Make a survey of the region to determine what kinds of agricultural seeds are locally grown for market. Also ascertain what kinds of seeds the region might well grow for market.

20. **Visit one or more seed stores** or places where seeds are sold and learn the sources of as many as possible.

21. **Seed Cleaning.**—Learn to clean seeds of weeds and trash by the use of a fanning mill; or visit a place where a fanning mill is in use.

22. **Studying Variation.**—In a thick patch of weeds or other plants, note the variations in height, size of stem, number of leaves, color of foliage, and other characteristics. Explain as many of these differences as you can.

23. **Extreme Variation.**—Find examples of extreme variation in wild or tame fruits or other plants. Of what advantage could these be in developing new varieties or strains?

24. **Selection by Growers.**—Visit truck gardeners, fruit growers, or professional plant breeders. Ask them to show results of careful selection in developing new strains.

25. **Weight of Seeds.**—Visit an implement house or seed store where a fanning mill may be studied. If possible obtain permission to run a peck or a bushel of seeds through the machine. Weigh the sample before and after. Note the difference in weights of quarts of uncleaned and cleaned seeds. Study the cleanings. This exercise may be continued as a project by growing a sample of the cleaned and uncleaned seeds and comparing the yields. Calculate the advantage to the whole state if seed cleaning were practised by all.

26. **Discussions and Debates.**—*a.* Each student should discuss at home what varieties of garden and field crops could be improved by home selection.

b. Discuss the probable need of a hive of bees in pollinating orchard fruits and small fruits.

c. Will it be advisable to have a distinct seed plot on the home farm this year?

QUESTIONS

1. Mention the conditions which influence the growth of plants.
2. What can you say of their temperature requirements?
3. How could you prove that plants need air? How do they get it?
4. Describe examples you have observed showing the light requirements of plants.
5. What is the office of chlorophyll? Where is it found?
6. What are the best conditions for germination?
7. What are the uses of roots?
8. Describe an experiment to show osmosis, and give its analogy to plant life.

9. What are the four most essential elements required in fertilizing soils?
10. Trace the function of water in the growth of plants.
11. How do trees prepare for winter?
12. How can you distinguish between fruit buds and shoot buds on a plum or peach tree?
13. Enumerate three reasons for the production of seeds.
14. What is the relation between flowers and seeds?
15. Explain what is meant by the terms *monœcious*, *diœcious* and *perfect flowers*.
16. Mention four plans in nature to prevent self-pollination.
17. What are the characteristics of flowers that are pollinated by insects? By wind?
18. What classes of food are sometimes stored in seeds?
19. Of what use is this food to the plant? To animals?
20. Give reasons for saving seeds from the home garden.
21. How may they be labeled? How stored?
22. Give some valuable precautions in buying seeds.
23. Describe some good methods of testing seeds.
24. What are the benefits of seed testing?
25. Of what value is state analysis to the grower? To honest seed dealers?
26. What are the most important causes of variation among plants?
27. What is meant by heredity? State the law briefly.
28. What is meant by the term *sports* in plant breeding?
29. What is De Vries' teaching regarding their use?
30. What are the effects of reversion in plant breeding?
31. Explain the meaning of *prepotency.*
32. How would you explain the importance of careful selection?
33. What are hybrids?
34. What is Mendel's law of fixation of type?
35. In what way is this law limited in use?
36. Give an example of the results of Mendel's law.
37. Give some advantages of using pedigreed seed.
38. Give an example of the value of attention to improvement.
39. Explain the use of a fanning mill in improving yields of crops.

References.—U. S. Farmers' Bulletin, 1390, *Vegetable Seeds for the Home and Market Garden; Botany for Secondary Schools*, L. H. Bailey (Macmillan); *Applied Economic Botany*, M. T. Cook (Lippincott); *Botany of Crop Plants*, W. W. Robbins (Blakiston); *General Botany*, E. N. Transeau (World); *Plant Genetics*, J. M. Coulter (U. of Chicago); *Orcharding*, Gardner, Bradford, and Hooker (McGraw-Hill).

CHAPTER II

APPLE AND PEAR ENTERPRISE

Collaborator, T. J. Talbert, A. M., Professor of Horticulture,
University of Missouri

Analysis into Jobs.—The following are the main teaching units or operative and managerial farm jobs in an apple or pear enterprise. The references are to United States Farmers' Bulletins. See also other authors, as Bailey, Gould, Waugh, and Sears.

1. Determining possibilities with apples and pears, 727, 1001, 1360, 1739.
2. Studying nursery methods, 702, 1369, 1397, 1567.
3. Choosing the kinds and varieties of fruit.
4. Choosing location, soil, and site.
5. Preparing the orchard soil, 1250, 1750, 1758.
6. Buying trees and receiving shipment.
7. Laying out the site and planting.
8. Growing intercrops.
9. Cultivating the orchard, 279, 945, 1307, 1518.
10. Fertilizing the orchard.
11. Pruning the orchard, 181.
12. Controlling diseases, 938, 1120, 1478, 1479.
13. Controlling biting insects and borers, 662, 675, 763, 835, 1065, 1270.
14. Controlling sucking insects, 650, 722, 835, 1128, 1270.
15. Making spray materials.
16. Spraying, 722, 1285, 1666, 1676.
17. Renovating old orchards, 1284.
18. Protecting against frost, 1096, 1588.
19. Harvesting the fruit.
20. Storing fruits, 852, 879, 1160, 1380.
21. Grading and packing fruit, 1080, 1204, 1434, 1457, 1695, 1752.
22. Marketing and using fruit, 900, 984, 1080, 1144, 1264, 1424, 1551.
23. Keeping financial accounts, 511, 572, 782, 1182.

Job 1. Determining Possibilities with Apples and Pears

Conditions Usually Found.—(1) Many people plant orchards and afterward neglect them. (2) Many home and commercial orchards are badly neglected or poorly managed.

Aims.—Students should know what soils, sites, and climatic conditions are best and what can be done with the fruit produced. They should understand the amount of labor involved and capital required, and the danger from insects and diseases.

Problems for Study and Discussion

1. What soils are best for apples and pears?

2. What regions are best for apples and pears?
3. Why are apples and pears less restricted than stone fruits in their regions of growth?
4. What are the best markets for surplus fruits grown in your region?
5. What prices were received for apples and pears last season?
6. How much annual labor is needed in caring for a bearing orchard?
7. Ask local growers whether insects and diseases are too destructive to warrant growing apples and pears.
8. How many of the best growers have mastered the technical knowledge of the control of these enemies?
9. How much time is required to bring apples and pears of different varieties to bearing age?
10. How much capital per acre would be required to take care of the orchard until ready to bear?
11. What allowance should be made for other crops grown between the trees while they are young?
12. Ask growers about the danger of overproduction of fruit.

Regions.—A good apple orchard is an attraction and a material asset to any home, whether in a village or in the open country. Apples are more commonly found on farms than any other orchard fruit. Figure 15 shows the apple regions of the United States. The extent of apple growing can be realized when we know that each dot on the map represents five hundred acres. Pear regions are shown in figure 16.

Danger of Enemies.—Apples are subject to a number of serious enemies, but the best growers have successfully controlled most of these. Forethought regarding them will prevent serious mistakes, as some orchards have been destroyed entirely because of failure to study enemies in advance.

Labor and Capital Involved.—Much time is required in establishing orchards. Some varieties may bear a few apples at five or six years of age, while others require about twice as many years. Early bearers are not prolific until eight or nine years after setting; other varieties are slower. However, orchards may be expected to last a generation or longer if given proper care and attention. The amount of labor and capital to be charged against each year's crop is comparatively small.

The money needed to establish an orchard must be considered and provided. Estimates and accurate data have shown that young bearing trees have cost the grower $150 to $300 per acre above the cost of land.

Markets.—The disposal to be made of the crop when grown must be studied carefully in advance. If a good local market can be depended on to consume the crop, so much the better. If shipments are to be made, facilities, rates, distances, and roads must be studied.

Job 2. Studying Nursery Methods

Conditions Usually Found.—(1) Orchardists and farmers usually need to know more about how young trees are produced to aid them in buying trees in-

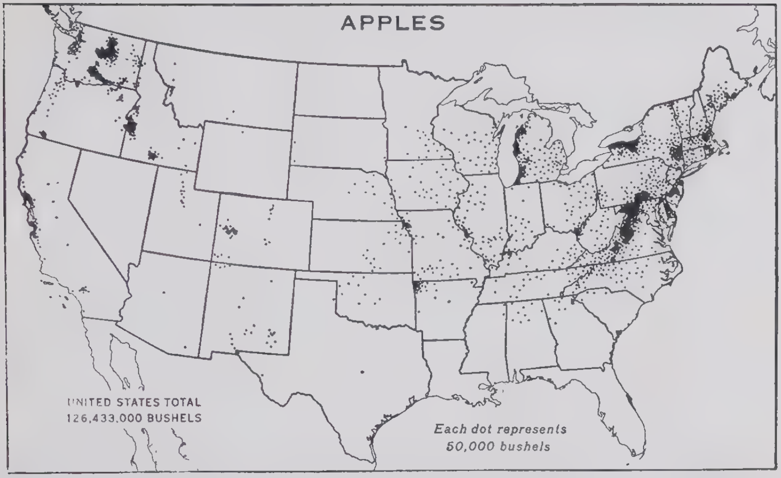


FIG. 15.—Commercial apple production in the U. S. Approximate total number of bushels is 126,433,000. Note that the chief production is in the eastern portion. (U. S. D. A.)

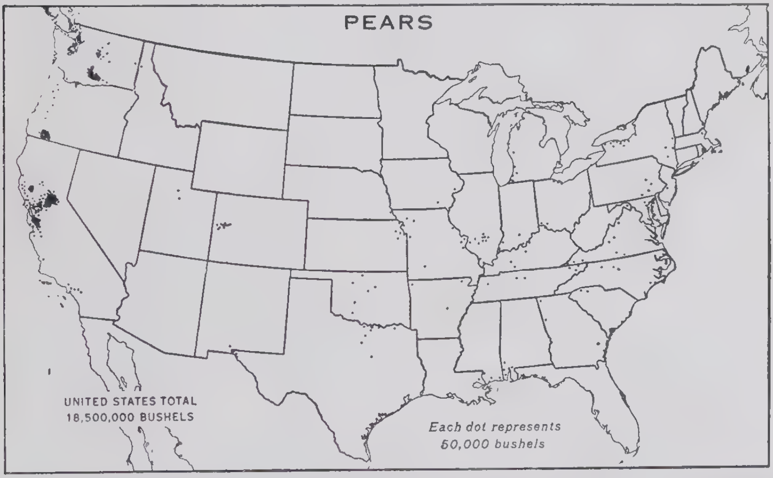


FIG. 16.—Commercial pear production in the U. S. Approximate total number of bushels is 18,500,000. A study of the production map shows a concentration of the industry in California, Oregon, and Washington. (U. S. D. A.)

telligently. (2) Very few orchardists practise top-grafting or top-budding even in cases where such would be profitable.

Aims.—(1) Students should understand the different methods of propagation of apples and pears and should be able to discover what methods were used on trees which they purchase. (2) They should know how to graft and bud, and should practise this knowledge in top-working and in propagating nursery trees.

Problems for Study and Discussion

1. What orchardists of your region seem to understand the details of grafting and budding young trees? Of old trees?
2. Which of these farmers propagate or top-work trees?
3. Where can seedling apple trees be obtained?
4. By inquiry or writing find what prices are charged for these.
5. How and when may apple seedlings be grafted or budded?
6. How are stocks and scions stored?
7. How are grafts set in the nursery row?
8. What care is given young trees in the nursery?
9. When is top-budding or top-grafting advisable in a growing orchard?

Activities.—1. **Grafting wax** should be made by students. Also wax a supply of knitting cotton after winding it into skeins eight or ten inches long and cutting the ends.

2. **Methods of Budding.**—With any suitable twigs make five or ten specimens of each of the principal methods of budding.

3. **Methods of grafting** should be practised in like manner until each method is well learned by every one.

4. **An apple or pear nursery** should be started as a home project. Follow the methods outlined in this chapter. Grow or buy the stocks, bud or graft them, prune the trees, cultivate and care for them for a season after the budding time. They may then be transplanted to orchard rows, or may be sold if the project is to close.

5. **Top-working** apple or other orchard trees is good practise. Use the budding and the cleft-grafting methods. When new varieties are thus inserted on trees of bearing age, note the success of the different methods used. Also note the time required to secure fruit on the new twigs.

Budding and Grafting Compared.—Budding is really a form of grafting in which a single bud is used. On the other hand we may say that grafting is a form of budding in which a twig bearing several buds is used. In each case the bud or twig is inserted upon another stem or root where it will grow and form a complete union. In grafting, the twig is called a scion and the stem or root to which it is attached is called a stock. The stems on which buds are placed in the budding operation are also called stocks.

Reproduction by Budding or Grafting—There are several principles to be kept in mind when plants are to be propagated by budding or by grafting.

1. Good varieties of peaches, plums, cherries, apples, pears, etc., may be propagated by using buds from them to grow on suitable stocks. Stocks bearing these buds, called scions, are often inserted as grafts.

2. Stocks are the roots or trees upon which the buds or scions are inserted for growth. The buds will grow if properly inserted on stocks closely related to the kind from which the buds were taken. Peaches and

plums may be grown on peach or plum stocks. Apples and pears may be grown on apple or quince stocks. The whole roots of seedlings are often used in grafting. If stocks are cut up they are called "piece-roots."

3. The stock does not influence the character of fruit borne by the tree resulting from this budding or grafting. The fruit is like the kind from which the bud was taken.

4. The stock may influence the character of growth and size of the tree resulting from the union. Thus quince stocks will cause pears and apples to be dwarfed in size, or Paradise apples, when used as stocks, will dwarf the trees. The stocks may also influence the power of resistance to disease or weather. Siberian crab apple stocks are often used for propagating apples in the coldest apple sections.

5. Top-working on young or old trees is sometimes practised for changing the variety of fruit. If this is done on trees newly set in the orchard it is called double-working. Trees of bearing age are sometimes worked over by cleft-grafting (Job 17). In this process small healthy limbs are cut off smooth and wedge-shape scions are made to insert as shown in figure 70.


FIG. 17.—An apple root grafted by the tongue method. The scion and root are cut about alike, then slipped together tightly and wrapped with waxed knitting cotton.

Budding Apples.—The shield-budding method is fully described in the peach enterprise. Apples are frequently propagated by budding. Seedlings grown in nursery rows for one season are budded with buds from desired varieties. This work is done out of doors toward the end of the growing season, about August or September.

Tongue-Grafting.—The particular form of grafting known as tongue-grafting or whip-grafting may be practiced either in the top working of trees or in root grafting young trees. The method is illustrated in figure 17. First a long sloping cut is made on the lower end of the scion, then a sloping cut somewhat resembling a split is made as shown. The upper end of the stock is cut in exactly the same manner. The two tongues formed are slipped under each other and the union is pressed together as closely as possible. If the scion and stock are of the same diameter, the growing layers of cambium just under the bark are adjacent to each other and will grow together. This forms a perfect union between the scion and stock. The grafted portion is wrapped with waxed knitting cotton or with waxed bands of old muslin. The wrapping is to hold the parts together and to aid in excluding the air. The wax also aids in keeping out surplus water.

Propagation of Apples by Grafting.—If apples are to be propa-

gated by root-grafting, the work may be done in the winter and much time of the nurseryman is saved. The roots are obtained from seedlings started from seed the preceding spring. These seedlings are dug in the fall with the entire tap root. They are tied in bundles of about one hundred each and stored in damp sand or damp sawdust in a cellar or storehouse where they will not freeze.

The scions for winter root-grafting are cut from improved varieties of apple trees, preferably of bearing age. These are of the last season's growth and bear shoot buds rather than fruit buds.

The roots may be cut in pieces about four to six inches in length or they may be left entire. Of course the top of the seedling is cut off and

Fig. 18.—Root grafts and cuttings are rapidly set out by thrusting them back of a spade which makes a narrow opening. (N. J. Station.)

discarded. Grafting of the scion and stock is then performed as already described. Bundles of root grafts containing from twenty-five to fifty each are tied securely around the point of union. These are labeled with wooden labels written in black lead pencil. If painted labels are used the writing will not be obliterated by mold or discoloration of the wood. The labels should indicate the variety of the scion, the number in the bundle and the date of the work. The scions and roots should be trimmed somewhat evenly at the top to make a neat bundle. Three, four, or more buds should remain on each graft.

The young root grafts should be stored in the same manner as the scions in damp sawdust in well drained boxes in a cool cellar or storehouse. In warm climates they are sometimes stored on the north sides of buildings or merely put into the ground until planting time.

Setting Out Grafts.—In the middle or late spring, grafts are set in

rows far enough apart to allow cultivation. An opening is made with a spade for each graft (Fig. 18). If the trees are eight to twelve inches apart and the rows three and a half feet apart, thorough tillage can be given them through the growing season. After one or two years' growth in the nursery they are ready to be transplanted to the orchard. Trees may be more suitably shaped to suit the ideals of the orchardist if they are transplanted at the end of one year's growth. The period is counted from the time the young root grafts are set in the nursery.

The depth of setting a young graft is important. Only one or two buds should be left to show above ground. The soil should be well firmed with the foot around each graft, but care must be exercised to avoid breaking off the buds in tramping. Apple trees will grow well in rich, mellow, black loam. All damage to the trees must be avoided during the growth in the nursery.

Other Types of Grafting.—For special purposes there are several forms of grafting much less common than the cleft-grafting and tongue-grafting already described.

Splice-grafting is fairly well described by its name. Two sloping cuts are made on the two pieces and these are laid together and tied.

Saddle-grafting is so named because the scion is split and set upon a wedge-shaped cut made at the top of the stock. This method is sometimes used near the surface of the ground in the propagation of some grapes. A mound of earth may be thrown around the grafted point after it has been tied.

Veneer-grafting is so named because an incision just through the bark is made on the stock. This is about an inch long. The base of the removed piece is cut off with a downward stroke leaving a little pocket. The scion is bevelled on one side slightly chiselled at the end to fit in this pocket and against the cut area of the stock. The graft must be very thoroughly tied to hold it in place. This method is much used in the propagation of ornamental and potted plants. It may be used when the scion and stock are of different sizes. A very small scion may be made to fit against the veneer cut on a large stock.

Side-Grafting.—Several forms are in use. A thin, wedge-shaped cut on the scion will fit under an opening in the bark of a large stock and the top of the stock need not be cut off until later. Bridge-grafting (Fig. 69) may use this form of graft.

The side-grafting cutting method differs from the last in having a wedge-shaped cut made on a small stock. This wedge is inserted under the bark of the scion or cutting. Careful tying is absolutely necessary. Waxing may also be used. Some grapes are grafted on roots by this method.

Shield-grafting is similar to prong-budding and may be called scion-budding. A bevelled scion is fitted under the T-shaped cut on the bark of the stock. It is then well tied and waxed.

Inlaying is so named because the wood of the scion is cut in exactly the same shape as the piece of wood removed from the stock. If a trough-shaped cut is made in the side of the stock then the scion is cut to fit this trough. It is then tied in place and waxed.

Grafting Wax.—There are three main ingredients in most grafting waxes, (1) resin (2) beeswax or paraffin (3) tallow, lard, linseed oil, or wagon grease.

A good formula is four parts by weight of resin, two parts by weight of wax, and one part by weight of grease. This makes a wax of medium hardness. For greenhouse work or for use in hot weather a harder wax may be desired. This is formed by using more resin and less grease. For outdoor work in cold weather a softer wax may be made by using less resin and more grease. If linseed oil is used in place of the heavier forms of grease, the wax is softer.

Directions for Making Grafting Wax.—Take an old can which is not soldered. Melt the resin in this can, add the wax, and lastly add the grease or oil. After thoroughly stirring, pour the melted mixture into water to cool. Grease the hands and pull like taffy. It should be pulled until it is all uniformly light in color. Then lay it on greased paper to cool.

When desired, a mass of the wax may be dipped into warm water and thus softened for use. It may also be heated in suitable containers.

Number 18 or number 20 knitting cotton is commonly purchased in balls. This may be wound off in skeins about eight inches long by wrapping on a board or book. The skein is cut at both ends and the strands tied by a cord around the center. This may be dipped into melted wax. Waxed knitting cotton may be softened to suit the desires of the grafter at any time by dipping it in warm water.

Rabbits and mice often girdle trees or scar them badly and must be kept out of the nursery. The rabbit trap shown in figure 19 will help to reduce the number of rabbits. Mice are present only when there is litter in which they may hide.

Growth of trees is very important and the trees must be kept growing rapidly throughout the growing season. Have them cultivated often and very carefully to induce a vigorous strong growth. Feed the trees well. The effect of fertilizer is shown in figure 20.

Inspection of Nurseries.—State laws provide for the inspection of nurseries at least once a year. The nursery is examined for injurious insects and diseases and a certificate of inspection is furnished. A copy

of this is printed on the tag used in shipping each lot of trees and shrubs, either within the state or across lines. The forms for these certificates vary somewhat in different states. That used in Missouri is typical.

Fig. 19

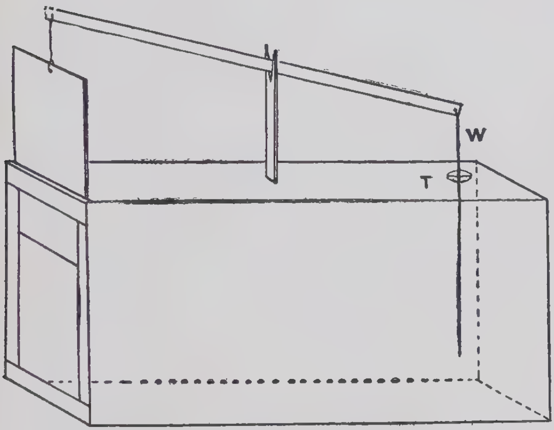


Fig. 20.

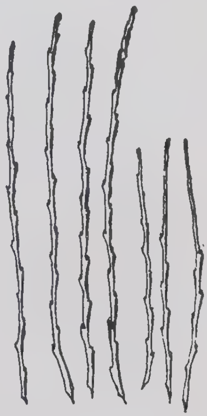


Fig. 19.—A box trap for rabbits is easily "set" by catching a notch in the wire, *W*, on a tin strip tacked on the box at *T*. The rabbit "snaps" the trap by touching the wire.

Fig. 20.—Twigs of one year's growth; left were from fertilized trees; right not fertilized.

MISSOURI STATE DEPARTMENT OF AGRICULTURE
J. C. BRESHEARS, Commissioner
JEFFERSON CITY

PACKAGE CERTIFICATE

No........................ Date Issued,.., 19......

THIS IS TO CERTIFY that, in accordance with the Missouri Plant Law, (as amended 1933), the plants or plant parts contained in this package have been inspected by a duly authorized entomologist and found apparently free from dangerous insects and plant diseases. This Certificate is not transferable, is subject to revocation and other penalties under the provisions of the laws relating thereto, and **expires 15 days after date of issuance.**

J. CARL DAWSON,
Plant Officer.

Countersigned by:

....

(Not valid unless countersigned.)

Fig. 21.—Inspection form. This certificate may have the name and address on the other side

Job 3. Choosing the Kinds and Varieties of Fruit

Conditions Usually Found.—(1) Many growers make careful selection of varieties and kinds of fruit for home and commercial orchards; but a few make

poor selections. (2) Growers sometimes make the mistake of planting commercial varieties for home use and home varieties for commercial use.

Aims.—(1) Students should know what factors govern the selection of varieties of trees. (2) They should make good lists for home planting and for commercial planting.

Problems for Study and Discussion

1. What local examples can you give of farmers planting too many varieties?
2. How many varieties of apples would you want in your home orchard for summer, for fall, and for winter? How many varieties of pears?
3. What difficulties at spraying and picking times arise from having too many varieties?
4. Discover to what diseases your apple varieties are susceptible or resistant.
5. Why should the exact ripening time or order of your varieties be well known?
6. Discuss the keeping qualities of each of the fall and winter apples and pears.
7. What varieties are commonly grown in your region?
8. Examine nursery catalogs and find the prices and descriptions of the fruits you have selected.

Activities.—(1) Visit fruit shows to study varieties. (2) Observe varieties in orchards of your region. (3) Collect specimens of fruits in markets and make comparative studies. (4) Tabulate local varieties in a table like that shown in this job. Beside season and use include quality, size, color, flavor, and keeping and shipping qualities. (5) With an apple score card, score several fruits of different varieties.

Varieties for the Home Apple Orchard.—Nurserymen speak of the varieties of apples under three heads, according to their seasons of ripening—summer, fall, and winter varieties. If the grower intends to have a surplus of apples for market he ought to be careful to have enough of one or two varieties rather than a few of a great number of varieties. When the orchard comes into bearing one of the most harassing things which will confront the grower is to spray and otherwise care for varieties which blossom and ripen at different times. This task will be greatly simplified if he has only a few varieties to demand his attention at spraying time, picking time, etc.

Why Only a Few.—In theory the home orchard which is not to have fruit for market may have a great number of varieties with only a tree or two of each kind. This sounds ideal, because the tastes of different members of the family at different seasons will be gratified and fruits for all purposes will be available. But several varieties of apples blossoming at different times may tend to confuse the grower in his efforts to interpret the spray calendar for the control of injurious insects and diseases. This problem is not as difficult as it may seem nor as was formerly believed. It is now found that sprays may be applied to fruit buds, when some blossoms are opening, or when only two-thirds of the petals have fallen—although never when the trees are in full bloom.

Varieties Suggested.—A good list of varieties for the home orchard will include one or two good standard varieties of summer apples, and one or two of the fall varieties; and the list should include good winter keepers. Perhaps three of the winter varieties of keepers will be enough.

If we bring this plan down to its simplest form we might have one summer variety such as Duchess, one fall variety, such as Grimes Golden or McIntosh Red, and one variety of winter apple such as Winesap or Newtown Pippin.

Guiding Principles.—In choosing the varieties for any region study the results of trials made by other growers. No general recommendation can be made which will include all regions and all soils. The glowing descriptions of catalogs or tree agents should not be taken to mean that the varieties are well suited to the region. There are many things to be considered in the choice of varieties: (1) Do the fruits hold on well? (2) Do they withstand bitter rot and other varietal diseases? (3) Do they grow to good size on these soils? (4) Do they keep well? (5) Do they yield well? (6) Do they bear regularly? (7) Does the tree make a thrifty growth? (8) Are the trees long lived? (9) Do the fruits stand handling? (10) Are the apples of good quality? The last point may be the sole subject of the discourse of a tree agent. If the variety falls down on all the other points, or any of them, the tenth point will not overcome the difficulties.

Write to your state experiment station and get a list of varieties recommended for planting in your region.

Resistant Varieties.—Some varieties of apples are more susceptible to certain diseases than others. Summaries have been made by experiment stations regarding resistance to scab, blotch, bitter rot, fire blight, and rust. Orchardists setting new plantations should study such tables carefully before buying varieties.

Variety	Scab	Blotch	Bitter Rot	Rust	Fire Blight
Ben Davis	VS	S	VS	S	R
Delicious	VS	VR	R	R	R
Duchess	VR	VS	O	R	S
Early-Harvest	VS	VS	O	R	VS
Grimes	VR	VR	VS	VR	S
Jonathan	VR	R	VS	VS	VS
Kinnaird	VS	VR	R	R	R
King David	R	R	VS	R	R
Maiden Blush	VR	VS	S	R	S
Paragon	S	R	R	R	R
Red June	VS	R	O	R	R
Rome Beauty	VS	R	R	S	S
Stayman	VR	VR	R	VR	R
Transparent	R	R	O	VR	VS
Wealthy	VR	VR	O	VS	VS
Winesap	S	VR	R	R	R
York	R	R	R	S	VS

Key: V, very; R, resistant; S, susceptible; O, ripens too early for rot.

Quality in Apples (Ohio and Oregon Stations)

	Variety	Season of Use	For Dessert	Culinary Uses				
				Sauce	Stewed	Pie	Baking	Jelly
1	Arkansas	February–May	*					
2	Arkansas Black	April–June			*		*	*
3	Astrachan	Early August		*				
4	Babbitt	December–March		*				
5	Baldwin	December–March	*		*	*	*	
6	Banana	December–February	*	*				
7	Benoni	Early August	*					
8	Blenheim	September–October		*				
9	Boiken	December–February		*				
10	Bough (sweet)	Early August	*					
11	Chenango	Late August	*					
12	Delicious	December–January	*				*	
13	Ensee	January–March	*		*			
14	Fall Pippin	Late September	*					*
15	Garden Royal	Early September	*		*		*	
16	Golden Sweet	March–August	*				*	
17	Gravenstein	Late August	*			*		
18	Grimes	October–March	*		*	*	*	
19	Hubbardston	November–February	*		*			
20	Ingram	March–June	*					
21	Isham (sweet)	Early October	*				*	
22	Jefferis	Early September	*			*	*	
23	Jersey Sweet	Early September	*					
24	Jonathan	December–March	*		*	*	*	*
25	King David	January–March	*		*			*
26	Late Strawberry	Late August	*		*	*		
27	Lawver	March–May						*
28	Lowell	Late August	*					
29	McIntosh	Early September	*					
30	Maiden Blush	Early September	*					*
31	Melon	Early September						*
32	Mother	Mid-September	*		*	*	*	
33	Moyer	November–February	*		*			
34	Munson (sweet)	Late August	*		*			
35	Northern Spy	October–January	*		*	*	*	*
36	Ohio Nonpareil	Late September	*				*	
37	Oldenburg	Early August		*				
38	Oliver Red	December–April	*		*		*	
39	Ralls	February–May	*					
40	Rambo	October–December	*	*			*	*
41	Red Canada	November–March	*			*		*
42	Red June	Late July	*			*	*	
43	Rhode Island	October–December	*		*	*		
44	Rome Beauty	January–March			*		*	
45	Roxbury	February–May	*					
46	San Jacinto	Late August	*					
47	Scott	February–May						*
48	Stark	January–April	*					
49	Stayman Winesap	January–May					*	
50	Summer King	Late August	*		*			
51	Summer Rambo	Early September	*					
52	Summer Rose	Late July	*					
53	Sutton	November–February	*		*		*	
54	Sweet Russet	Early October	*				*	
55	Sweet Winesap	November–December	*		*		*	
56	Tolman (sweet)	November–January	*				*	
57	Tompkins King	October–December	*	*			*	*
58	Wagener	December–February	*					*
59	Wealthy	September			*	*		
60	White Pippin	February–May	*				*	
61	Winesap	February–May	*		*	*	*	*
62	Winter Paradise (sweet)	January–March	*					
63	Yellow Transparent	July	*	*				
64	York Imperial	February–May			*			

Job 4. Choosing Location, Soil, and Site

Conditions Usually Found.—(1) In regions where the land is hilly, growers usually choose suitable sites; but a few make mistakes. (2) The soil and site are sometimes not suited to the particular type of fruit to be raised.

Aims.—(1) Students should learn the fundamentals of orchard site selection. (2) They should understand the factors involved and should have practise in applying these.

Problems for Study and Discussion

1. Give examples of orchards in your region which are well located; which are badly located.
2. Why is air drainage an important factor in choosing an orchard site? How is air drainage secured?
3. In a level region, what factors should govern the location of the orchard? Discuss distance from public road and distance from house.
4. How can you judge from the growth of other plants whether or not the soil is suitable for orchard planting?
5. Why should orchards have well drained soil?
6. Why is the subsoil to be considered in orchard planting?
7. What type of soil is best for apples and pears?
8. Why would you need to be nearer market and have better transportation facilities for marketing summer varieties than for marketing winter varieties?
9. With a list of factors influencing the location of an orchard site in your mind, choose several good locations in your neighborhood.

Activities.—(1) Collect samples of soils and subsoils from orchard sites. (2) Compare these in suitability for apples and pears. (3) In early spring compare soil temperatures on northern and southern slopes. (4) Dig holes in poorly drained sites in wet weather to study drainage conditions.

Location and Exposure of the Apple Orchard.—The grower should not be discouraged if he has not the best location for the apple orchard. The exposure should not be toward the westerly winds if that can be avoided. A north or northeast slope is better. (Fig. 22.) This will keep the soil cool in the spring and prevent the warm days from forcing the trees into blossom so early as those on a southern slope. The earliest blossoms are in greatest danger from late spring frosts.

One of the most important considerations in the location of the apple orchard is the finding of a slope and putting the orchard near the top of it. This will give air drainage, which is the best protection against damage from late spring frosts. When frosty nights occur the cold air settles in the low places, and blossoms are often damaged here when those at the top of the hill are uninjured.

If possible, locate the apple orchard near enough the farm buildings so that it can be easily watched. Not only does the orchard need protection from human marauders at fruiting time, but it should be under the eye of the owner so that he will give it better protection against insect enemies and plant diseases. Fruit trees along the roads may satisfy those who would otherwise enter the orchard. They may also supply some fruit for home use.

Soils.—In well settled regions the experience of the older residents

will tell whether the soil is suited to the growth of apple trees. If trees have made a vigorous growth their size taken into consideration with their age will tell the tale. In poor apple soils the growth will be meager or poor. Soil also influences the length of life of apple trees. Medium loams and heavy loams are to be preferred to the light sandy soils for apples. The soil does not need to be extremely rich, but a moderate degree of fertility is desired.

Soils for pears should be fully as heavy as for apples, but if they are too rich the pears are likely to be more susceptible to fire blight.

FIG. 22.—A splendid orchard site on a northeast slope; but the orchard was ruined by the owner's greed in trying to raise two crops where only one should have been grown.

Drainage.—Neither apples nor pears can thrive in soil which is not well drained. Natural drainage seems to be more desirable than artificial drainage. Trees will not thrive in wet areas in the orchard.

Job 5. Preparing the Orchard Soil

Conditions Usually Found.—(1) Loss of young trees often results from improper preparation of the soil before planting. (2) Most growers prepare the soil very well before planting.

Aim.—Students should learn how properly to prepare soil for planting fruit trees.

Problems for Study and Discussion

1. Why should the orchard site be chosen six months or a year before planting time?
2. Under what conditions should a green-manure crop be plowed under before planting an orchard?
3. How long before planting should the land be plowed?
4. Why is deep plowing for an orchard important?
5. Describe a good physical condition of the top soil for planting.

6. What implements should be used in preparing the surface?
7. How does a smooth surface aid in marking off the rows?

Activities.—(1) Make tests of subsoil to determine whether deep plowing should be practised in preparing for orchard planting. (2) Test the values of two sods by examining each for its amount of organic matter.

Planning in Advance.—If the orchard soil is in old, tough sod, it may need to rot for a year before trees are planted. Well rotted organic matter is very helpful in the growth of the young orchard.

Fall Plowing.—Soil should be plowed very deep, and if possible should be plowed in the fall if the trees are to be planted the following spring. Orchardists sometimes plow both in fall and in spring. The fall plowing may be to turn over a thin layer of sod, with the spring

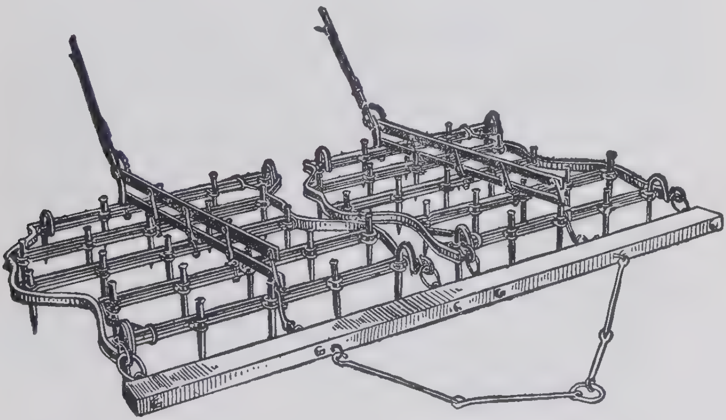


Fig. 23.—The spike-tooth harrow with lever adjustments by which the slant of the teeth is controlled.

plowing much deeper. Deep tillage machines are sometimes used in working the soil to a sufficient depth before planting trees. There is less danger of injury from the turning up of new subsoil for orchard trees than for ordinary farm crops.

Disking and Harrowing.—The surface should be thoroughly disked after spring plowing or should be disked early if the spring plowing is omitted. After this the spike-tooth harrow should be used. (Fig. 23.)

If the surface is cloddy or otherwise rough, a plank drag used after the harrow will leave the surface in much better condition for marking off the rows and setting the orchard in a creditable manner.

Job 6. Buying Trees and Receiving Shipment

Conditions Usually Found.—(1) A few growers discover too late that they have been fooled by agents or irresponsible persons when buying trees. (2) Diseased or inferior trees are sometimes planted. (3) Very few farmers go to the nurseries and carefully select healthy trees.

Aims.—(1) Students should realize the importance of selecting good trees. (2) They should understand and practise the best methods of obtaining nursery stock.

Problems for Study and Discussion

1. What growers in your region buy nursery stock from agents? From nurseries?
2. Who among your neighbors graft or bud their own trees?
3. How long in advance should young trees be selected?
4. Discuss local vs. distant nurseries for trees.
5. What advantages are gained by visiting the nursery before buying?
6. What age of apple or pear tree is best to purchase?
7. Give arguments for and against buying two-year-old apple trees.
8. Describe the appearance of crown gall and club root on nursery trees.
9. When should these troubles and other diseases be discovered?
10. When should the young trees be shipped from nursery to orchard?
11. Describe inspection of young trees when unpacked from shipping boxes.
12. Tell how and why to heel-in young trees.
13. Why should an agreement be made regarding the destruction or return to the nursery of unhealthy or inferior trees?
14. Why should the labels on each variety be carefully noted and saved?

Activities.—(1) Visit a nursery to inspect shipments, or visit an orchard when trees are being received. (2) Assist in unpacking and heeling-in the trees.

Obtaining trees is usually done in one of three ways: (1) ordering from traveling agents—the poorest way; (2) ordering from reliable nurseries by catalogs; (3) growing your own trees. The second method is usually followed by commercial orchardists. Each nursery usually grows varieties that are most popular in its territory. After deciding upon your numbers and list, place your order with the nursery as many months in advance of shipment as possible. State the diameter of tree one foot from the ground, the age, and the number of each variety. Reliable nurseries do not make substitutions unless your order allows it, but many mistakes are made even in the best nurseries. If possible visit the nursery before ordering.

Local vs. Distant Nurseries.—For several reasons local nurseries are to be preferred over distant nurseries. (1) The buyer may visit the nursery more easily. (2) Nurseries may be more considerate of orchardists whom they know personally. (3) Trees may be better acclimated. (4) In case of trouble regarding diseases or mixture of varieties, adjustments are more easily made. (5) Trees are less likely to suffer during shipment. (6) The shipping costs are less.

Age of Trees.—It should be a rule to plant one-year-old apples and pears, but frequently two-year-old trees are used. The points in favor of planting yearlings rather than two-year-old trees are: (1) You get

first choice from the nursery. (2) You can head back the trees to suit your plans. (3) They cost less. (4) They transplant more successfully. The argument advanced for planting two-year-old trees is that they may bear sooner after transplanting, but this is not true.

Inspecting Shipment.—Shipments received from nurseries should be unpacked immediately. The roots should be placed in contact with the soil promptly. When doing this, inspect the roots and crowns very carefully. Every tree should be examined to be sure that there is no crown gall, club root, or other trouble. Sometimes roots are infested with plant lice. If troubles of any kind are found the specimens should be shown immediately to authorities who can testify to the conditions.

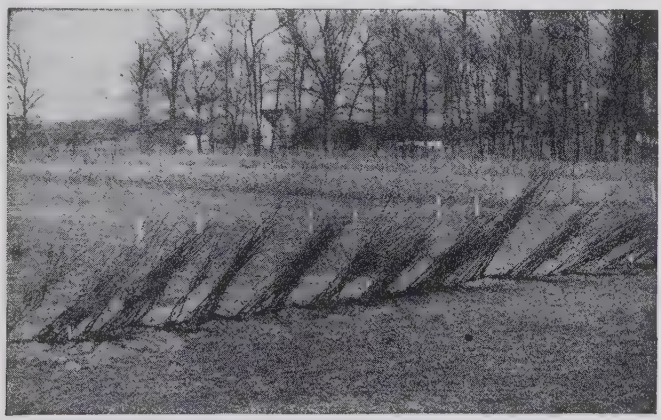


Fig. 24.—Fruit trees should be heeled-in as soon as received or when dug from the nursery. Tramp the soil well about the roots. (Indiana Station.)

Then make a statement immediately to the shipper. Usually if any trees are found showing trouble, the whole shipment is apt to be affected with the same trouble. It may be best to reject the whole shipment. Some orchardists make definite agreements in advance with the nurserymen for the rejection of shipments if not satisfactory.

Heeling-In.—This consists in digging a trench of suitable depth so the roots may be placed in it and the tops leaned over to one side. The roots are then covered with plenty of soil to protect them from drying out. (Fig. 24.)

Even if the trees are to be planted very soon, heeling-in should not be omitted. The bundle should be opened so the soil will come in contact with all the roots. The trees and labels may be selected more easily for planting in the different rows as desired when they are heeled-in.

Workmen are liable to expose the roots and greatly injure them if they have not been heeled-in.

Job 7. Laying Out the Site and Planting

Conditions Usually Found.—(1) Most orchards are planted by the square method. (2) Many growers use a "filler" system, as peaches with apples. (3) Experienced planters plant trees successfully.

Aims.—(1) Students should learn the different methods of laying out orchards. (2) They should know the reasons for and against using the filler plan of planting. (3) They should learn how to plant trees properly.

Problems for Study and Discussion

1. By what plans were the orchards of your region planted?
2. How many orchardists used a filler system?
3. Give examples of growers who planted early-bearing apples among late-bearing varieties.
4. Give reasons for planting early-bearing trees of any kind as fillers among those which come to bearing later.
5. What dangers are found at spraying time where this method is used?
6. What is likely to happen when it is time for the fillers to be cut out of the orchard? Give examples of this.
7. Describe how the land is marked off for planting by the square system.
8. Describe how the land is marked off for planting by the triangle or hexagon system.
9. Give proper intervals for your region and your soil for the planting of apple trees; pear trees.
10. How are the holes for planting most economically dug?
11. Give arguments for and against using dynamite in making the holes.
12. How can trees be taken from the heeling-in place to the orchard holes with least danger?
13. Why should tree roots not be exposed long to sun and wind?
14. How large should the tree holes be made before planting?
15. Describe the structure and use of a planting board.
16. Why should there be good soil in the bottom of each tree hole?
17. Why should the soil be tramped firmly against the roots?
18. Under what conditions would you want to leave a little depression around the tree? When level or hilled up?
19. Under what conditions would you put some manure in each tree hole, and just where would you use this?

Activities.—Practise making good tree holes and properly planting trees.

Use of Fillers.—Some trees come to bearing much younger than others. If these are mingled in the orchard by planting early bearers among the late bearers, fruit will be secured sooner. The early bearing trees are called "fillers," the others "permanent." When the permanent trees become large enough to fill all the space, the fillers are to be removed. Herein lies a great difficulty; the manager seldom cuts the fillers as soon as they begin to interfere with the permanent trees. Some spraying difficulties also occur in mixing varieties which do not blossom at the same time. (Fig. 25.)

Intervals with and without Fillers.—Apple trees become so large when full grown that they must be planted at intervals varying

from 30 to 40 feet each way. If they are started at half these distances three-fourths of the trees will have to be cut out to prevent too much crowding. This thinning of the trees in an apple orchard is difficult because each tree is considered so valuable when it is large and is bearing fruit that the grower does not "have the heart" to cut the trees.

Intercropping with other trees such as peaches or pears or plums is sometimes practised. If the apple trees are planted 40 feet apart each way and the peach trees are planted half way between them in

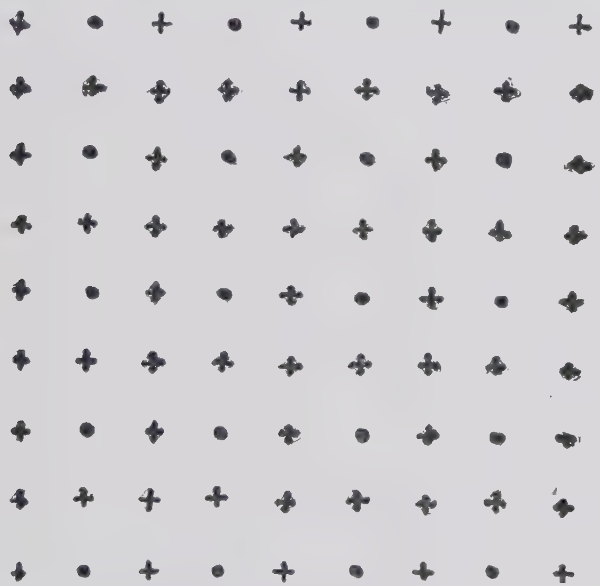


Fig. 25.—A plan of planting the orchard using the filler system. Black dots are the permanent trees; others are temporary.

the same rows and an extra row of peaches 20 feet apart is planted between each two rows of apples, this will make 27 apple trees per acre and three times that number or 81 peach trees, making a total of 108 trees to the acre.

Plan of Planting.—The rectangular plan of laying out the orchard is most common. Two lines running from one corner are established with stakes. Enough stakes are placed along these two lines to establish the rows in both directions. By measuring with a pole from the stakes in these two lines it is easy to locate all of the balance of the trees in the orchard (Fig. 26).

Trouble at Spraying Time.—When a variety which bears at an early age is used as a filler among the permanent trees that are not likely to blossom at the same time, fighting insect pests will be more difficult because of the difference in advancement of the trees during the spring season. Petals will fall from one variety earlier than from the other and each must be sprayed at as nearly the right time as possible. Workmen become confused regarding the trees to spray, and much injury may result or trees may be skipped unintentionally.

Holes for Setting Trees.—Holes may be dug some time in advance of planting and should always be ready before the trees are taken to the

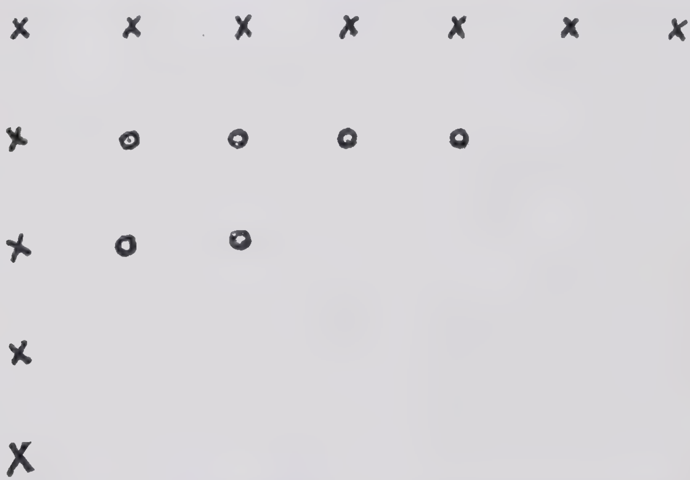


Fig. 26.—Plan for setting an orchard. X's are stakes set at right angles along two sides. The places for all other trees, O, are easily obtained by measuring with two poles from adjacent stakes.

field. They should be deeper and much wider than the roots require, so that good top soil may be placed below the roots and around them when planting. Trees are also to be planted about one to one and one-half inches deeper than they grew in the nursery.

After the lines are staked out, a planting board (Fig. 27) should be used so that the trees when planted will be in line.

The use of dynamite has been recommended for making tree holes. If the soil is not too heavy nor too wet, this may result in better growth of the trees, but sometimes conditions are very unfavorable and the explosion of dynamite may form around the hole a "jug" of hard clay which will prove detrimental.

Pruning before Planting.—When everything is ready for planting the trees may be taken up and pruned before planting. Cut off all the broken roots and trim away any diseased or injured parts. Prune the top somewhat severely so as to balance the loss of roots occasioned by the digging. One-year-old trees have buds throughout, and the pruning will be simply cutting off all the top down to a height of about two feet.

Two-year-old trees are much more difficult to handle in this regard. The buds are on only the last season's growth, and good judgment must be exercised to decide which old branches should be left. It is often impossible to make a low-headed tree when two-year-old nursery trees are being planted. Try to leave such branches as will balance the head of the tree when these become the main head limbs. If the branches are the same height on the main shaft of the tree they will tend to split, and the tree when loaded with fruit will be seriously injured.

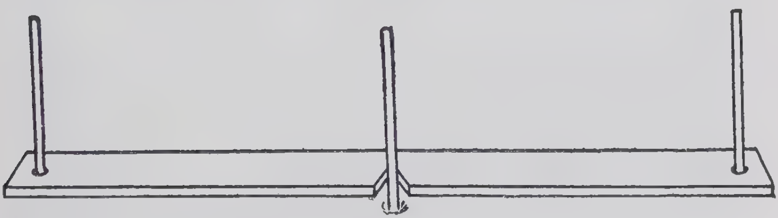


Fig. 27.—A planting board used as shown makes it easy to place the tree exactly where the stake was placed for it.

Height of Head.—When the main branches start out near the ground the tree is said to be low-headed. If the trunk is three or four feet below the main branches the tree is called high-headed. (Fig. 28.)

Many orchardists now head trees low at planting time. This makes them easier to spray and prune; the fruit is easier to harvest, and the trees are less apt to split and break in heavy winds or when loaded with fruit. Cultivation near the trees is more difficult unless special implements are used. Compare the trees shown here as to height of trunks, figures 28, 60, 66, 67.

Moving Young Trees to the Orchard.—On sunny or windy days much damage may occur when trees are carelessly moved from the heeling-in place to the orchard. Trees may be heeled-in near the center of the orchard. The roots may be placed in a barrel or tub of very muddy water which is hauled along the row as the trees are set.

Planting an Orchard Tree.—The hole for the planting of a tree should be considerably larger than the area covered by the roots. It should also be deep enough so that some of the best soil may be thrown

back into the hole before planting. The tree should also be set an inch or two deeper than it was in the nursery. After getting the tree in its exact position throw some of the best soil over the roots and tramp this firmly in place. If any manure is to be added it should be put above this and not too close to the tree. Only a little manure for each tree should be used at planting time. When filling in the balance of the soil an occasional tramping is best. Leave some loose soil on top to form a mulch and prevent evaporation. It is necessary to have the soil well firmed against the main trunk so that it will not be blown over by the wind. A little manure may be used on top of the soil. It serves as a mulch, and the nourishment will be leached into the soil gradually by rains.

Fig. 28.—Trees with high heads and long trunks need propping more than do low-headed trees. Thinning the fruit would save some of the propping.

If a stake is driven where each of the trees is to be planted it is easy to sight along these rows of stakes and straighten the row if necessary. As each stake is removed by the digger when making the hole for the tree it is necessary to mark its location before it is lifted out. This is done by using a planting board as shown in figure 27. Two stakes are placed in the line of stakes to suit the length of the planting board. The notch at its center is held on the stake where the tree is to be planted until the other two stakes are driven in place. Then the stake is removed and the hole may be dug. When the tree is planted the notch on the planting board will locate the trunk of the tree exactly.

Job 8. Growing Intercrops

Conditions Usually Found.—(1) Too many farmers grow corn or sow small grain among the young trees of the orchard. (2) A few growers use well-chosen crops between the rows of young trees.

Aims.—(1) Students should know the advantages of growing annual crops among young trees. (2) They should know which crops are best for this purpose in their region.

Problems for Study and Discussion

1. Make a list of different varieties with the time required to bring each to bearing.
2. What financial gain may come from growing truck crops or other money crops between the rows of young trees?
3. How may the choice of intercrop influence the shape of the trees?
4. How may it influence the cultivation of the trees?
5. How may a poor choice of intercrop injure the trees?
6. What suitable crops are grown among young trees in your region?
7. Compare the following for this purpose: early potatoes, beans, beets, early cabbage, early turnips, onions.
8. How is late cultivation of the intercrop apt to cause trees to be injured the following winter?
9. In regions where a winter cover crop should be grown and turned under in the spring, what intercrop should be grown in the summer?

Activities.—A project in intercropping may be conducted by each student in his home orchard.

Waiting for a Fruit Crop.—Some varieties of apples and pears may bear as young as four or five years of age. Missouri Pippin, Wealthy, and Oldenburg are apples which come to bearing early. Northwestern Greening, Transparent, and others may not bear until they are eight or ten years of age. During the waiting period the space between the trees may be used to good advantage for financial returns.

Reasons for Intercropping.—Making use of the areas between young orchard trees is justified by the following reasons: (1) Financial returns may be secured while waiting for the fruit crop. (2) The orchard is cultivated without extra labor while the intercrop is being tilled. (3) Closer attention to the condition and growth of trees is given. (4) Fertilizers applied to the intercrop may also benefit trees.

Choosing Intercrops.—Avoid tall crops such as corn or small grain which would tend to shade or distort the growth of trees. Avoid crops which would grow late in the summer or fall and cause the soil to be dug up when they are being harvested. Late digging might stimulate the growth of wood on the trees or delay the maturing of buds for winter protection.

Choose crops which complete their growth early. Choose those which will not harbor enemies likely to injure the trees. Choose crops which do not grow above the trees. Choose crops which are not likely to rob trees of their nourishment and moisture at the critical season of growth.

Suitable Crops.—In many regions early Irish potatoes, bush beans, garden or stock beets, onions, and other truck crops may be grown for market or for farm use. Cabbage is likely to be affected with club root,

which is also dangerous to orchard trees. Some varieties of cowpeas and soybeans are affected with nematodes which also attack the trees.

Job 9. Cultivating the Orchard

Conditions Usually Found.—Many home orchards and some commercial orchards are not properly cultivated.

Aim.—Students should learn the most economical methods of systematically cultivating growing orchards.

Problems for Study and Discussion

1. What farmers in your region practise clean cultivation of the orchard each year?
2. What is their annual plan of cultivation?
3. What others do you know who have grass or other crops permanently in their orchards?
4. Debate these two methods of orchard management.
5. Describe good orchard cultivators.
6. What relation has good cultivation to the size and abundance of fruit?
7. What relation has it to diseases and insects?

Activities.—(1) Different methods of cultivation should be conducted for comparative study. (2) Compare sod orchards and cultivated orchards in growth of trees and calculate the yields per tree in both cases.

Clean vs. Sod Culture.—Systematic tillage of orchards results in several benefits: (1) causes the roots to feed deep; (2) conserves soil moisture and checks damage from drouth; (3) makes plant food more available to the trees; (4) the fruit is larger and more abundant; (5) diseases and insects are more easily controlled; (6) allows the use of leguminous cover crops which supply nitrogen; (7) damage from mice and rabbits is less.

The claims for maintaining a permanent sod in the orchard are: (1) less labor and expense; (2) fruit sometimes more highly colored; (3) suits low heading better; (4) less washing on slopes not terraced; (5) windfall fruits are less damaged; (6) spring spraying and pruning may be easier.

The New York Station found the following comparisons:

	Sod	Tillage
Fruits per barrel	434	309
Barrels per tree	2.8	4.2
Net profit per acre	$71.52	$110.93
Gain in tree diameter	1.1	2.1

Annual Tillage Plan.—Unless washing is likely to occur, orchards should be cultivated annually. The soil should be plowed or deeply disked (Fig. 29) each spring to turn under a cover crop as green manure,

thus fertilizing the orchard. If this green manure includes a leguminous crop it will probably supply plenty of nitrogen for the orchard. Harrow the surface just after plowing and repeat this soon after every heavy rain. In mid-summer, or soon after, sow a cover crop to remain during the winter and to be used as green manure the following spring, usually rye and vetch in the north and rye with crimson clover farther south.

FIG. 29.—A common disk harrow may be attached to the ends of an extension bar to cultivate under orchard trees. (New Jersey Station.)

Job 10. Fertilizing the Orchard

Conditions Usually Found.—(1) Even in regions where soils are poor, farmers often neglect the fertilizing of orchards. (2) Commercial orchards are usually properly fertilized.

Aim.—Students should understand how properly to fertilize as to kind, time, and amount.

Problems for Study and Discussion

1. What fertilizing of orchards do you find in your region?
2. How many farmers who grow intercrops fertilize the trees also?
3. What kinds of fertilizer are used to supply nitrogen, phosphoric acid, potash?
4. Why should these be applied separately or mixed at home?
5. Why should summer varieties be fertilized just after picking?
6. How can a farmer judge from the growth of trees and fruit what fertilizers are necessary?
7. Give the characteristic effects on the growth of trees and the bearing of fruit of nitrogen, of phosphoric acid, and of potash.

Activities.—(1) Conduct trials with young trees to prove the value of nitrogenous fertilizers. (2) With bearing trees make trials to test the values of phosphoric-acid and potash fertilizers.

Fertilizing the Orchard.—Early applications of nitrogen in quickly available forms generally stimulate a greater set of fruit the same season. The forms of nitrogen most used for this purpose consist of sulphate of ammonia and nitrate of soda, which may be used in varying amounts from about one-half pound for apple and pear trees, one to two years old, up to five or six pounds or more for trees ranging in age from 18 to

25 years old. Such inorganic forms of artificial fertilizers seem to give quicker results than organic forms.

Apple orchards in sod generally require fertilization to maintain yield and growth of the trees, while orchards which are well cultivated may not respond readily to chemical fertilizers. Growth and yield are not an-

Fig. 30.—After being starved for years this tree was made productive by feeding with acid phosphate and nitrate of soda. (Ohio Station.)

tagonistic, but usually go hand in hand. In fairly fertile soils both cultivation and fertilization are not usually required. This is particularly true where leguminous cover crops are being grown in the orchard.

Effects of Nitrogen.—The one element most notably needed in apple orchards is nitrogen. This may be the first limiting factor so far as soil fertility is concerned, and it may give as good results for at least a

few years as a complete fertilizer, although for some soils the latter may in the long run be more desirable.

The color of apples may be influenced materially by fertilization. Where the stimulus produces considerable growth apples are likely to be poor in color, although larger in size, and somewhat later in maturing. A very heavy set, however, may result in a decrease in the size of the individual fruits; while if a moderate crop is set the fruit is almost sure to be larger in size.

FIG. 31.—Effect of fertilizing a neglected orchard. Yield of fertilized row 46 barrels, unfertilized row nine barrels. (Ohio Station.)

Other Forms of Fertilizer.—If a good supply of organic matter has been turned under, little if any nitrogen will be needed. Soils containing considerable clay need not be heavily fertilized with potash. Phosphoric acid may be needed on many orchard soils. An available commercial form for this is superphosphate (acid phosphate), which carries about 16 per cent of phosphoric acid. Basic slag, a by-product from steel furnaces, averages about 18 per cent and is much prized by apple growers. The use of phosphoric acid stimulates growth of roots and stems, improves quality of fruits and seeds, hastens ripening of fruit, and increases resistance to disease. (Fig. 30).

When potash is needed, particularly in light soils, it may be applied in the form of kainit, muriate of potash, or wood ashes. Potash stimulates vigor of growth and seed and fruit production. It balances the effect of nitrogen and increases resistance to disease. Increases in yields due to fertilizing are shown in figure 31.

Need of Lime.—To maintain growth and fruitfulness in orchards which are intercropped it is usually advisable to manure or fertilize them. So far as apple or pear trees are concerned, the addition of lime is rarely necessary. To produce better growth of the cover crop or intercrop it may be necessary to make applications of lime. By so doing the grower is able to build up the nitrogen content of the soil through the growing of leguminous crops such as clover, alfalfa, cowpeas, soybeans, vetch, etc.

Avoiding Twig Blight.—On account of the danger of fire blight, a bacterial disease, pears are not as a rule fertilized, although they may be given some fertilization and cultivation where the disease is not serious. Heavy, succulent, vegetative growth is more likely to be affected by the fire blight disease. Control of the growth of pear trees, making it sufficient for fruitfulness and at the same time reduced enough to prevent serious injury by blight, is the most important problem of the pear grower.

Home Mixing of Fertilizers.—Careful orchardists can seldom afford to buy ready-mixed fertilizers. A close study of bud formation, growth of wood and fruiting habits of the trees will indicate what special plant foods are needed. Ready-mixed fertilizers will seldom be found to meet the varying conditions in an orchard.

HOME-MIXED FERTILIZERS

Are easily mixed
Reduce cost
Save labor
Suit soil needs
Meet crop wants
Avoid filler
Reduce fraud
May be winter job
Make better farmers

Job 11. Pruning the Orchard

Conditions Usually Found.—(1) Home orchards are often not pruned or badly pruned. (2) Commercial orchards are more commonly pruned as they should be.

Aims.—(1) Students should understand the importance and best methods of pruning. (2) They should become skilful and rapid in this work.

Problems for Study and Discussion

1. What orchards in your region are properly pruned?
2. Can you point out any which are not properly pruned?
3. What others are never pruned?
4. What reasons are given by farmers for not pruning their trees?
5. Find orchards which you would call high headed.
6. What ones are low headed?
7. What effect does pruning have on the quality and size of fruit?
8. Why should pruning precede spraying?
9. How does pruning allow the spraying to be more thorough?
10. In what sense is pruning a form of thinning fruit?

Activities.—(1) Collect examples showing results of improper pruning. (2) Find cases where properly treated wounds have healed over well. (3) Secure a good limb showing locations and growth of fruit spurs.

Fig. 32.—Farmer with good pruning tools saves time and labor. (U. S. D. A.)

Pruning before Spraying.—Pruning and spraying are winter jobs. An early start will complete pruning before the dormant sprays are applied. Included in the reasons for pruning before spraying are the increased ease with which the sprayer can reach all parts of the tree with a saving of time and spray material. On the pruned tree too, the sprayer is less apt to neglect the parts difficult to reach, thinking that they will be removed later when the pruning is resumed. Burn all trash.

Low vs. High Heading.—Orchardists differ on the practices of heading the trees high or low (Figs. 59, 60). This matter must be decided when the tree is first pruned. The points in favor of low heading are: (1) top pruning is easier; (2) thorough spraying is more easily accomplished; (3) harvesting the fruit is more rapid and less laborious; (4) limbs are less

likely to be broken by the weight of fruit and by harvesting; (5) less propping is necessary; (6) more trees per acre may be grown.

The points in favor of the old high-heading plan are these: (1) Cultivation near the trees is easier; (2) there is less danger to the limbs during cultivation; (3) more air circulates about the trees, possibly avoiding some disease.

Pruning Young Orchards.—Reference has already been made to the matter of heading to the height desired just before or after setting. Follow this the same summer by removing with the thumb any sprouts that would tend to form undesirable branches. Each winter or early spring prune with hand shears or sharp knives, keeping these principles in mind: (1) the shoots which are to form the main branches of the future

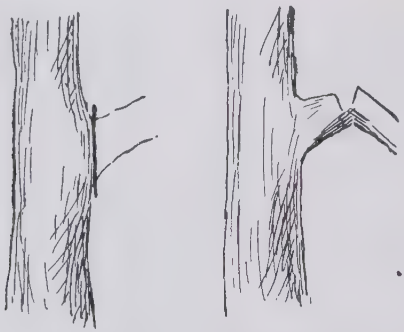


FIG. 33.—Good and bad pruning contrasted. Cut close when removing large limbs. Cut from the under side first to prevent splitting down the bark.

tree should be at different heights on the trunk to avoid splitting when heavily loaded with fruit; (2) these branches should extend toward the different points of the compass; (3) the number should be from three to five; (4) the main shaft of the tree must not be allowed to form other branches which will overshadow the main ones you have selected.

In doing this pruning always cut close (Fig. 33) to the trunk or branch, never leaving a stub. Such stubs will die for want of leaf surface. A dead stub is "like a thorn in the flesh." It must decay and causes disease of the tissue. When cut close the under bark will burl over the wound and protect it from the weather. All large wounds should be painted with good oil paint of some kind.

Pruning Bearing Trees.—To understand how properly to prune a fruit tree one must know how the fruit is borne by that kind of tree. Apples are borne on spurs which form fruit buds (Fig. 34). This is true

of pears and some types of plums. Other types of plums and all peaches are borne on the youngest twigs. Several points should be remembered in pruning bearing trees: (1) remove all diseased parts; (2) remove all broken or injured branches; (3) allow sunlight to enter the top; (4) remove limbs that tend to cross the head of the tree; (5) when two or more shoots are parallel remove all but one; (6) cut back new growths enough to cause

Fig. 34.—Fruit spurs of apple. *A* to *A* shows one year's growth marked by the rings or scars of the terminal bud scales. *B* shows where fruit was attached; the number of crops may be counted. The fruit buds, *C*, are downy and are larger than shoot buds, *D*. (Indiana Station.)

the tree to remain within desired heights; (7) cut back new growth on the sides enough to cause branching and keep the tree within bounds.

Pruning the Orchard.—Much of the vigor and health of the orchard depends upon the annual pruning. Most of this work will be done in the winter when other farm work is less pressing (Fig. 35). But some light pruning in midsummer is valuable, particularly with young trees. Pruning the orchard is as important as spraying, cultivating, or fertilizing.

Figure 34 shows the fruit spurs of the apple tree. In pruning old trees

we should be careful not to remove such spurs. There are a number of points to be remembered by the operator while doing the annual winter pruning.

Fig. 35.—A light pruning each winter keeps the home orchard trees within bounds. The winter cover crop of rye makes the work more pleasant and benefits the soil. (Indiana Station.)

1. Remove all dead or diseased parts and burn those affected with blight or other serious disease.
2. Cut out broken limbs.

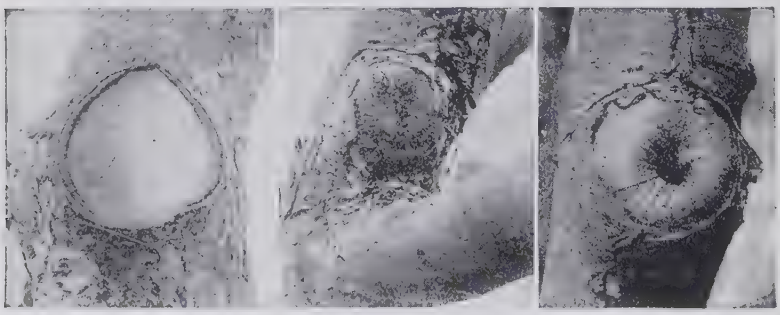


Fig. 36.—Pruning of large limbs should be as close as possible to allow the bark and live wood to cover the wound as shown in the central figure. Decay may begin before the new growth covers the wound, and a deep hole is formed, as shown at the right.

3. Prune out all those twigs which strike across the body of the tree.
4. When two or more limbs extend along the same line or closely parallel each other, prune away the less vigorous.

5. Thin the head of the tree enough to admit plenty of light and air to all parts. Never allow crowding in the tree top.

6. Cut back some of the new growth on young trees or on any that grow rapidly. A third or a half of such growth is often pruned back.

7. Make all cuts close to the axis, (Fig. 36). Never leave a stub to die and cause disease.

8. Make all cuts as smooth as possible and paint the wounds of large cuts to prevent decay.

9. Avoid cutting large limbs if possible. This may be done best when annual pruning is diligently followed.

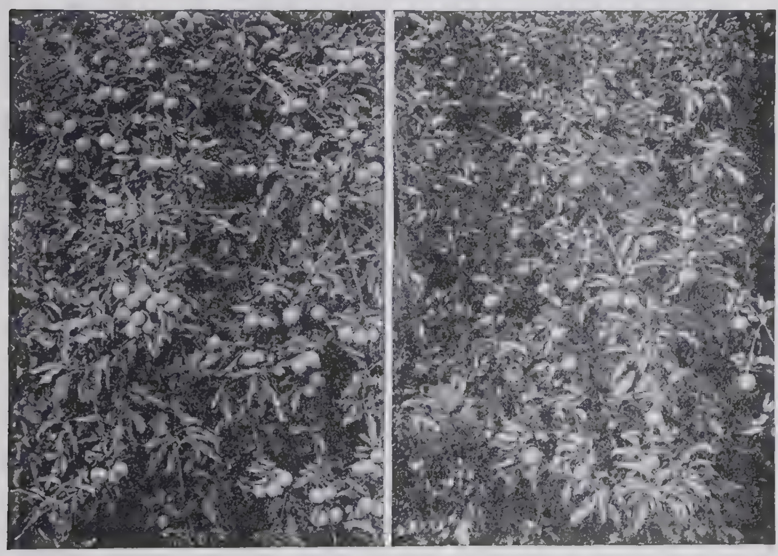


Fig. 37.—Gano apples, before and after thinning. It takes courage to thin fruit, but the size is increased enough to pay. (Ohio Station, Newark.)

Thinning Fruit.—Figure 37 shows young apples before and after thinning. This work is done when the fruit is quite small, and as soon after the June drop as possible. Not more than one apple should be left to each spur, and the apples should be thinned to a distance of 4 to 8 inches apart on the branches. Removed fruit may be dropped to the ground.

The objects of thinning are (1) to prevent the spread of rot or other disease of the fruit; (2) to increase the size and quality of the fruit left on the trees; (3) to induce the tree to bear a good crop annually instead of

every other year; (4) to save work at harvest time in picking and sorting low-grade fruit; (5) to prevent the breakage of limbs.

Job 12. Controlling Diseases

Conditions Usually Found.—(1) Diseases of apples and pears are very destructive in all orchards where they are not fought. (2) Home orchards are more commonly neglected than commercial orchards.

Aims.—Young orchardists should understand the several diseases of apples and pears and should know how to prevent their injuries.

Problems for Study and Discussion

1. What diseases have been most serious in your region?
2. Describe the attacks of apple scab and discuss losses due to this disease.
3. What varieties in your region have been affected with blotch? With bitter rot? With apple rust?
4. Describe the effects of each of these diseases.

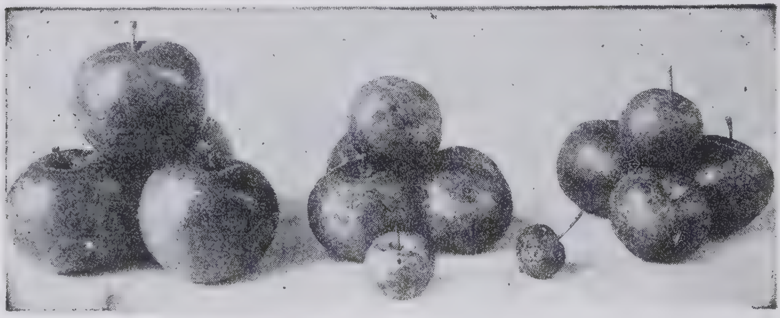


FIG. 38.—Scab disease and sooty blotch on apples compared with sound specimens on the left. (Ohio Station.)

5. To what extent are fire blight, canker, and sun scald found in your region?
6. Describe the methods of controlling these three troubles.

Activities.—(1) **Collect specimens** of insects and specimens of fruit, twigs, etc., showing the damage done by various diseases and insects. Among these try to secure both apple rust and cedar apples. Keep these at school for future reference. (2) **Practice combating enemies** by all the methods suggested for each. Determine which are the best remedies.

Apple Scab.—Probably the worst disease of the apple is apple scab. This fungous growth attacks the leaves, small twigs, and the young fruits themselves (Fig. 38). The scabby appearance formed on the fruit gives origin to the name. The disease lives from one season to another in the form of spores on the trees and in the leaves under the trees.

The winter spraying for San José scale described under the head of peach growing will destroy many of the winter spores of the scab disease.

The orchard should again be sprayed with lime-sulfur or Bordeaux mixture about the time when the buds are opening and before the blossoms are open.

Fire Blight.—Pears, apples, and quinces are subject to attacks of a bacterial disease known as twig blight, pear blight, fire blight, etc. Small twigs are seen to turn brown after the leaves have formed. This may prove very serious, as the attacks may extend into the larger branches and destroy nearly all the new growth each season.

Control measures are not satisfactory. Remedies are quoted from Missouri Station Cir. 137.

"**Cut Out and Burn the Hold-Over Cankers.**—In the control of fire blight the first and most important object should be ridding the orchard of the source of the disease. Since the hold-over cankers found mainly on pear trees are the source, these are the first factors requiring the attention of the grower. A few badly blighted pear trees are of little if any economic importance, but they may act as the main source of blight infection for many acres of apples. The destruction of such diseased pear trees before growth starts is emphasized. In the regular dormant pruning work, the grower should also be careful to remove and burn the blight cankers from all apple trees, as some varieties of apples, as well as all varieties of pears, may have hold-over cankers. In removing the blighted twigs and cankers, it is well to cut all infected twigs from 6 to 8 inches below the cankered area in order to be sure of eliminating all the parts infected with the fire-blight bacteria. The hold-over cankers on large limbs and the trunk should be treated likewise, removing the bark about 6 inches above and below and from 2 to 4 inches on the side.

''Such cuts and wounds should be disinfected with a 1-500 solution of equal parts of bichloride of mercury and cyanide of mercury. To prevent spreading the disease, the pruning implements should also be disinfected after each cut by washing or dipping them in the disinfectant. The disinfectant may be applied to the wounds and pruning tools by means of a sponge or several thicknesses of a soft cloth tied around a stick about 12 to 16 inches long. All cut surfaces should be painted after the disinfectant has dried, using ordinary barn paint, white lead and raw linseed oil. Since these disinfectants are highly poisonous, great care should be taken in handling them.

''If pruning is done during the growing season, the wounds should be disinfected and painted promptly. Cutting out blight and burning the diseased wood during the dormant season are recommended. It is, however, impractical to attempt to cut out during the spring or summer the thousands of blighted twigs that may appear in large trees. The germs of blight in these dying twigs are very short lived and may have run their course and become incapable of causing new infection before the twigs are cut away.

''Since it is very probable that fire blight may be carried over winter on the crab apple and hawthorn such infected trees in the vicinity of apple orchards should be destroyed or given fire-blight treatment as applied to pear and apple trees.

"**Control Injurious Insects.**—This includes fruit tree borers, sucking insects like aphids, and leaf hoppers; and biting and chewing insects like the

curculio and the codling moth. There are many other good reasons for the control of these insect pests. Fire blight alone, however, is a sufficient reason for their control, since all at times may become carriers of the disease.

"**Regulate the Growth of the Fruit Trees.**—It is more important that the pear make a slow, steady, and uniform growth than the apple, because as a rule it is more seriously affected by fire blight. Both fruits, however, should be given close attention as regards growth. The grower at all times should see that the trees make a fairly strong, vigorous, satisfactory growth. With young trees this is very important. Should fire blight become serious, however, it may be necessary to check the growth of the trees by withholding fertilization and cultivation, one or both practices, depending upon the need."

Bitter Rot.—The apple fruits are attacked by a disease known as bitter rot. The fungous growth starts in a small spot on the surface when the fruit is growing on the tree. These spots enlarge until they cover large areas and reach to the center of the apples. Several spots blend into each other and the whole fruit is finally destroyed. Certain varieties of sweet apples are more subject to the disease than others. Bentley Sweet, for example, is quite subject to attacks of bitter rot.

Spraying with Bordeaux mixture during late July and early August at intervals of 10 to 12 days is considered the best remedy for this disease.

Apple Canker.—This form of attack is noticed on the large twigs and main branches, and sometimes on the trunk of trees. The best remedy is to scrape away and thoroughly cleanse the diseased parts. Wash with copper-sulfate solution. Spraying thoroughly with lime-sulfur is believed to be helpful. Scraping and cleaning, however, should always precede the washing with antiseptics.

Sun Scald.—The appearance of sun scald is somewhat similar to that of canker disease. The bark on the main parts dies and peels from an attack of sun scald. Scraping clean and washing with antiseptics are recommended.

In setting young trees care should be exercised to allow their own growth to shade their trunks. Trees are sometimes severely attacked by sun scald after a winter with much snow. It is supposed that the reflection of the sun from the surface of the snow will blister the bark so openly exposed at that season of the year. Painting the trunks with whitewash will protect them in the winter as well as in the summer. This method may be easily practised in the home orchard.

Apple rust is a fungous disease which seriously attacks the leaves, twigs, and young fruits of pears and apples. The fungus has an alternate generation in the form of a fleshy growth on cedar trees, known as the cedar apple (Figs. 39 and 40).

A remedy for the disease is to cut down all cedar trees in the vicinity

Fig. 39.—Rust on apple leaf, somewhat enlarged, showing the cup-like fungous growth. (Indiana Station.)

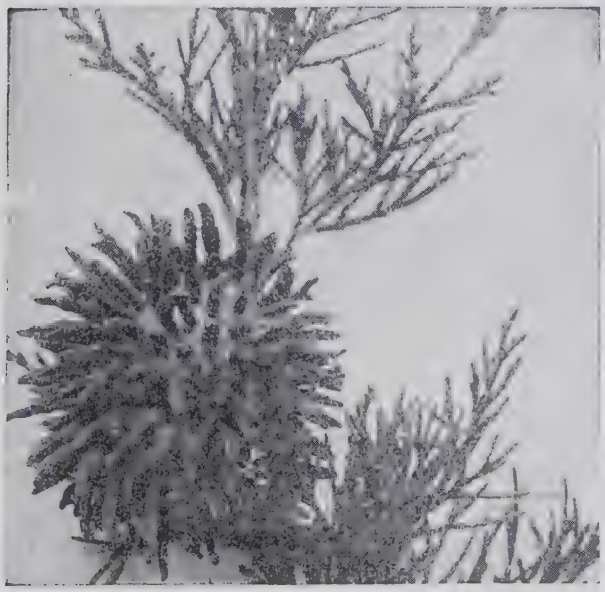


Fig. 40.—Apple rust fungus on the cedar, called "cedar apple." Spores from this generation infest the apple, as shown. (Indiana Station.)

of the orchard. Spraying as for scab with lime-sulfur or Bordeaux mixture will aid in controlling the rust.

Frog-eye and blotch are fungous growths that injure the leaves (Fig. 41). They also attack the twigs and fruit of apples. The sprayings recommended for scab disease will usually control frog-eye and blotch on most varieties, except where blotch is serious.

Blotch Diseases.—This disease produces eruptions upon the twigs and small branches and characteristic little brown spots upon the leaves. The cankers persist from year to year, scattering spores to new tissues each season. Attacks upon the fruit appear in small star-shaped black spots. The blackened area spreads and swells and eruptions of spores appear. Large roughened spots on the fruit may follow later.

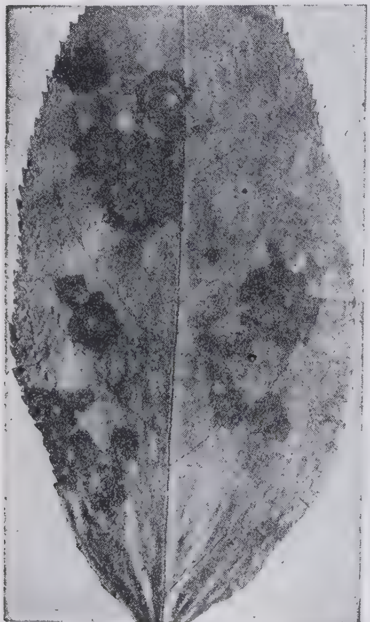


Fig. 41.—Frog-eye leaf spot disease on apple leaf. The usual spraying to prevent scab holds this disease in check. (Virginia Station.)

Resistant varieties should be used where the disease is prevalent. Where blotch is troublesome in the apple orchard thorough Bordeaux sprays generally give better results than lime-sulfur applications. The first blotch spray should be made about two weeks after the calyx spray. About four or five later sprays should follow at intervals of ten to twelve days.

Phoma Fruit Spot.—In this disease black or brown depressed spots appear on the fruit, resembling an incipient stage of blotch; but there is a flecked appearance to the spots. This fungous disease is distributed in New England and is reported in Illinois and adjacent states. It is especially common in the Yellow Bellflower and Talman Sweet varieties.

The disease can be controlled by applying late sprays as for blotch and bitter-rot diseases. The late scab spray may be sufficient. See spraying schedule.

Job 13. Controlling Biting Insects and Borers

Conditions Usually Found.—(1) Apple worms, borers, and other biting insects are found as enemies in all apple and pear orchards. (2) Thorough methods of controlling these enemies are successfully followed by the best orchardists.

Aims.—Orchardists should understand the work and life history of each of these enemies and the best methods of controlling each.

Problems for Study and Discussion

1. Ask growers what percentage of their fruit is affected with codling moth.
2. Ask them how serious are apple borers in their orchards.
3. Find their methods of fighting borers.
4. Describe the life history of the codling moth and suggest good methods of fighting it.
5. Describe the attacks of apple borers of two kinds.
6. Tell how to fight each of these.
7. What injuries are done by canker worms? How should these be controlled?
8. Describe the appearance and injury of tent caterpillars.
9. Give their life history and control.
10. Describe injuries due to pear slugs.
11. Describe the work of apple maggots and their control.

Activities.—(1) Practise digging out borers from apple tree trunks. (2) Collect insects and specimens showing their injury for study at home and at school.

Principles of Fighting Biting Insects.—There are a number of important principles to be borne in mind in fighting biting insects. First, make sure that the insects are of the biting kind. By observing their work, see what damage is being done. If the surface of the leaves is being taken by them, or if the leaves are being eaten in any way, or if the fruit is bitten, then you know that the insects are of this type. Poison sprays should be applied as soon as the work of the biting insects begins. Success depends upon getting them before they do much damage.

The spraying material must be strong enough to poison the insects, and should be made attractive enough so that they will eat it. Usually the leaves will be attraction enough, but some sweetening is sometimes used.

Danger to foliage must be avoided. In nearly all cases danger is averted by the use of lime added to the water sprays, or by using Bordeaux mixture containing plenty of lime.

Insects which are soon to become imbedded in fruits must be poisoned at the very moment they are entering the fruits; for example, apple worm and plum curculio insects. It is necessary that the poison be on the surface ready for the insect to get his first mouthful, otherwise spraying would be too late.

Apple Maggot.—This enemy is sometimes called the railroad worm. It burrows through the flesh of the apple fruit, causing blemishes and tunnels. The fruit becomes practically worthless as human food. Fruits often fall to the ground and the larvæ crawl out and enter the soil to pass the pupa stage. The adults emerge the following summer and soon begin laying eggs. Mild-flavored varieties seem to be preferred by these insects.

Clean-up methods are recommended. Swine and poultry in the orchard should help. Clean cultivation in rather early spring may kill many

insects in the pupa stage. The usual spraying campaign for other insects should aid in controlling these maggots.

Codling Moth.—One of the worst apple insects is the codling moth, or apple worm. It is the insect which makes apples, pears, and other core fruits wormy. The adult moth lays eggs in early spring on the leaves and fruit. As soon as the eggs hatch the larvæ eat their way toward the center of the fruit, and when fully fed emerge from the surface and drop to the ground from a suspended web fiber. In many cases the apples drop to the ground with the larvæ in them. When the young emerge they may go to the trunk of the tree and form cocoons or nests in crevices of the bark. Here they rest for a few weeks, or if the season is short they may spend the winter in this larval or worm stage. Where the season is long a second

Fig. 42.—Three stages for spraying apple and pear trees. 1, winter buds open, spray for scab, aphids, and bud moth. 2, pink or pre-blossom, spray for scab, bud moth, and leaf roller. 3, calyx spray for scab and codling moth. (Oregon Station.)

and a third brood of moths lay eggs on the surface of the half-grown apples, and the young do much damage by burrowing tunnels through the fruit. Wormy apples are almost worthless on the market.

The best remedy is to spray the trees just after the petals fall. Never spray when the trees are in full bloom because of danger to bees which are pollinating the fruit. The spraying should be done before the calyx cups close and before the young apples begin to hang downward (Figs. 42 and 43).

The spray materials used should all contain arsenical poison so that the young larvæ will be killed as soon as they begin to eat their way into the fruits. Arsenate of lead is usually preferred to Paris green. As the apple has a number of diseases, lime-sulfur or Bordeaux is usually applied at the same time. Arsenate of lead powder is mixed with lime-sulfur or Bordeaux at the rate of about 1 to 1½ pounds of poison to each 50 gallons and

applied as fine spray. This should not only be done just after the petals fall, but should be repeated at intervals of about two weeks up to within 5 or 6 weeks of harvest time. (See spray schedule; Job 16). This will counteract the attacks of the latest insects of the spring brood.

Apple Borers.—The apple tree is attacked by several borers. The most common of these is the so-called flat headed apple tree borer, which is the larva of a buprestid beetle. The larva lives in the tree about one year and burrows chiefly in the sap wood and green bark. As it girdles around the tree it causes much damage, and trees are often killed when attacked by several borers.

Another common apple tree borer is the so-called round headed borer, which is the larva of a beautiful long-horned beetle (Fig. 44). It lives

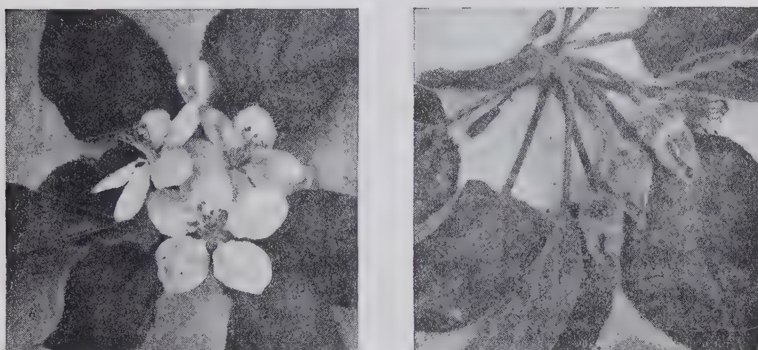


Fig. 43.—Two conditions of the apple or pear when a spray would not be applied. When blossoms are open pollen and bees would be injured. Just after the calyx cups have closed and the stems are hanging down a poison cannot enter the cups for codling moth.

in the trunk of the tree about three years and burrows in the heart wood as well as the sap wood.

The remedies for these apple borers are mechanical. The larvæ must be found and killed before they have done much damage. Cut away the outer bark with the point of a knife or wire and destroy the larva. The trunk of the tree may be protected from the adults by bands of paper or other materials which will keep the adult beetles from laying their eggs on the trunk. Netting shown in figure 45 may be fine enough to keep out these beetles. Repellent washes are sometimes used. The best of these are lime-sulfur and whitewash.

Canker Worm.—This is sometimes called a measuring worm, as the feet of the larvæ are at the two ends of the body, and the insect seems to be measuring the distance as it travels. These occur in large numbers in the trees and destroy the leaves. As the leaves of a tree are its lungs and

digestive organs it suffers greatly from the attacks of this insect. All biting insects can be readily destroyed by applications of poison. Arsenate of lead with summer-strength lime-sulfur is used when attacks are noticed.

Tent Caterpillar.—There are two forms of tent caterpillar which commonly attack trees. The larva of the apple tent caterpillar has a row of yellow dots down the middle of the back instead of a yellow stripe found

Fig. 44.—Adult beetle of the round headed apple tree borer. The holes show the wounds made by the insects. The larvæ are very destructive to apple trees. Watch the base of the trees and when borings are found follow the channels with a wire and crush the insects. (West Virginia Station.)

on the forest tent caterpillar. Both of these attack a number of kinds of trees, and as their work and remedies are somewhat similar they may be considered together. The egg clusters are formed around the twigs of the trees and may be seen in winter when there are no leaves on the trees. These may be pruned off and destroyed. In the spring when the eggs hatch the young soon form webs as homes, from which they make attacks on the leaf growth.

The web may be burned with torches of kerosene on long poles. Many

caterpillars are thus destroyed with a minimum of injury to the tree. Another remedy is to spray the tree all over with arsenical poison, such as arsenate of lead. This will poison the larvæ when they are seeking their food.

Pear Slugs.—These insects eat the surface of leaves of pears and some other fruit trees. They eat the green parts of the leaves and leave

FIG. 45.—Netting around the base of tree to protect from mice, rabbits, and borers. (Indiana Station.)

the skeletons of the leaves attached to the trees. The leaves turn brown and attract the attention of the owner. The larvæ spend the winter in the soil and emerge through the pupa stage in late spring or early summer.

Spraying with arsenate of lead or other poisons will control this enemy. Applications of contact insecticides will also help, so in fighting other enemies the slugs are easily controlled.

Curculio on Core Fruits.—A species of curculio closely resembling the one which attacks peaches, plums, and cherries is an enemy of the apple and other core fruits. Figure 46 shows the bad effects of this insect. The wounds in the young fruits, made by the insect in biting the skin, cause a deformity. This may make much of the fruit unfit for market.

Fig. 46.—Apples deformed and stunted by attacks of curculio beetles.

Job 14. Controlling Sucking Insects

Conditions Usually Found.—(1) San José scale, plant lice, and some other sucking insects are usually found in all orchards. (2) Great losses occur from San José scale and plant lice unless they are controlled.

Aims.—Beginners should study these enemies carefully and understand best methods of controlling them.

Problems for Study and Discussion

1. How many orchardists understand the attacks of this group of insects?
2. How many of them have lost trees from these enemies?
3. Describe the effects of San José scale on orchard trees.
4. Outline a method of controlling scale insects by use of lime sulfur.
5. Describe a plan for fighting scale insects with miscible oils.
6. Describe the attacks of plant lice.
7. Give methods of controlling plant lice.
8. Describe the work of red mites and tell how to control them.

The San José scale is very destructive to the orchard. Figures 47 and 48 show the insect. It is prevalent in all parts of the country, attacks nearly all kinds of fruit trees and shrubs, and is very serious on many forms of shade and ornamental plants. But the pest is not so serious that it requires the destruction of the trees by man, as methods of control are now well understood.

Thorough spraying in the winter with lime-sulfur or with miscible oil will usually keep this pest in check. We can never get rid of the insect entirely, but the annual spraying is beneficial for other purposes, and the extra cost of the battle due to the presence of the scale is very slight. The trees should be sprayed very thoroughly just after the winter pruning is completed. Select a warm, bright day in winter and spray thoroughly

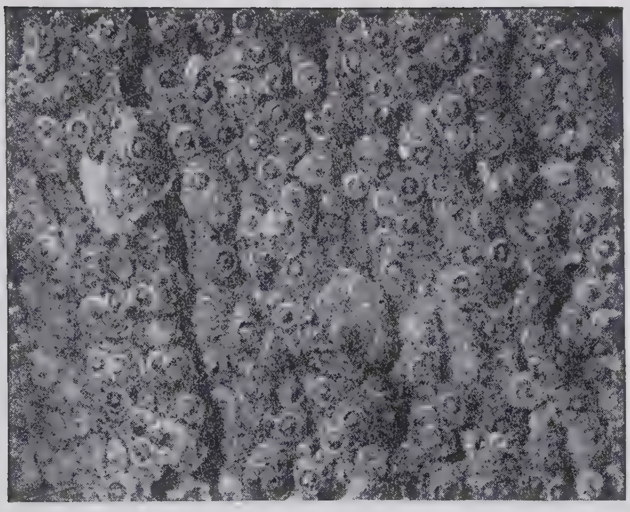


FIG. 47.—San José scale on twig, as seen under magnifying lens or microscope. (Kentucky Station.)

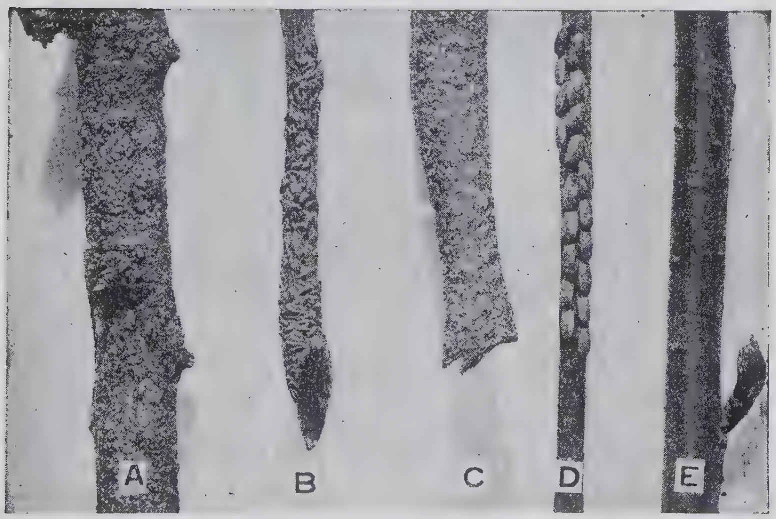


FIG. 48.—Three left twigs infested with scale insects. *A*, San José scale; *B*, oyster-shell bark-louse; *C*, the scurfy bark-louse. *D*, eggs of green grass-hoppers, sometimes mistaken for scale. *E*, healthy twig. (Kentucky Station.)

from top to bottom of the tree. Let no spot be skipped. If the scale is very severe two sprayings may be necessary. The first spraying may be applied in the late fall or early winter just after the leaves have dropped. At this time use the miscible oil. The next spraying can be with lime-sulfur. This should be completed before the buds begin to swell in the spring.

Apple Aphis.—These insects pass the winter chiefly in the egg stage. The eggs may be seen as shiny black dots about the buds of the preceding year. They hatch in early spring about the time the buds begin to swell. They attack the young tissues as soon as the buds have opened and do serious damage by distorting and dwarfing the tissues as they suck the sap. They multiply rapidly and later attack the leaves of the trees, causing them to curl into knots.

The best time to fight these lice is in very early spring soon after the eggs hatch. Spray with lime-sulfur or with nicotine when buds appear in the pink stage or a little earlier. Some orchardists delay the last winter spraying for San José scale enough to fight the lice at the same time.

Woolly Aphis.—Cotton-like masses are often seen on twigs, in the angles of leaves and branches, and on the roots of apples and pears. These are really plant lice covered with a downy mass. Galls are often produced on the roots by their sucking the sap. The forms which appear above ground can be controlled by nicotine in the spraying campaign. Growers sometimes dig about the roots of trees affected with woolly aphis and apply liberal quantities of tobacco dust or tobacco stems. Soil may be thrown over this material. The results are often beneficial by producing a stronger growth at least. Vigorous growth is always helpful. This can be produced by pruning, fertilizing, and cultivating.

Blister Mites.—This pest is frequently injurious to the foliage of apples and pears. It is not a true insect but a microscopic mite. It passes the winter under the scales of buds. When the leaves open in the spring the mites enter them, inducing blisters or galls where their colonies are formed.

Spraying with lime-sulfur in early spring will kill many of the mites before they enter the leaves. Spraying for San José scale is usually effective against this enemy. If nicotine is used against plant lice when the buds are in the pink stage, mites will be controlled.

Pear Psylla.—Insects of this type are also called jumping lice. They are such serious enemies of pear trees as to cause the dropping of leaves and fruit.

Control measures are very difficult. Winter spraying with 3 per cent miscible oil is done about the time the insects emerge from winter hiding places, as under the bark. If the insects appear in summer they are first

noticed by the presence of honeydew on the leaves. Nicotine sulfate is the best material to use at this time. Use one pint of nicotine sulfate and 30 pounds of fine hydrated lime in 100 gallons of material. Nicotine may be applied in Bordeaux mixture.

Job 15. Making Spray Materials

Conditions Usually Found.—(1) Many orchardists fail to spray because of not knowing how to prepare materials. (2) Some commercial growers buy materials already prepared at additional cost to avoid having to prepare materials at home. (3) Many successful orchardists prepare their own spray materials.

Aims.—Students should understand formulas and methods of preparing lime-sulfur, Bordeaux mixture, miscible oils, nicotine-sulfate sprays, and dusting materials, and how to combine different spray materials for various purposes.

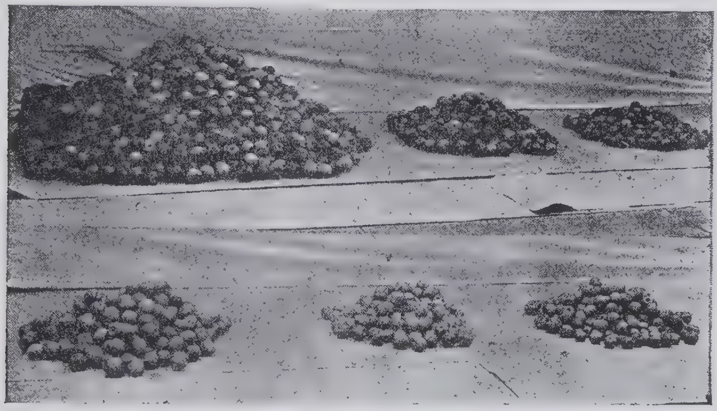


Fig. 49.—For spraying apple orchards lime-sulfur and arsenate of lead (shown above) are better than Bordeaux mixture and arsenate of lead (shown below). Upper and lower lots each from a tree sprayed three times. (Illinois Station.)

Problems for Study and Discussion

1. How many local orchardists prepare any of their spray or dusting materials at home?
2. How many of them buy ready-mixed materials for spraying and dusting?
3. Give the formula for home-prepared lime-sulfur and the dilutions for winter and for summer use.
4. Describe the boiling of lime-sulfur by the kettle method. By the steam method.
5. Give directions for making Bordeaux stock solutions.
6. Describe a good method for mixing large quantities of Bordeaux for spraying large orchards.
7. Why should Bordeaux be mixed only at the time of using?
8. Give a formula for making miscible oil.
9. Describe the steps for this.
10. What spray materials can be safely mixed and applied together?
11. At what rate would you mix arsenate of lead with Bordeaux or with lime-sulfur?

Activities.—(1) Practise making stock solutions of Bordeaux mixture. (2) Make up a stock solution of miscible oil. (3) Make up a stock solution of home boiled lime-sulfur.

Purposes of Spraying.—Too few who need to spray know the principles of spraying. It is necessary that the grower know what to spray for, and what and when to spray (Fig. 49). There are several purposes in view when a spraying campaign is conducted: (1) to prevent disease, (2) to fight insects which suck juices of plants, (3) to kill insects which eat the

Figs. 50 and 51.—Spraying improves quality and increases yield. Sprayed tree at left bore four barrels of apples, 87 per cent marketable. Unsprayed tree at right bore one barrel, only 13 per cent marketable. Note also the difference in leaves. (Missouri Station.)

leaves or other tissues of the plants. The materials used for these three purposes are of different character. One should not be used for the other, but sometimes the poison sprays for chewing or eating insects may be combined with the materials used to prevent disease.

Spraying pays in dollars. The best orchardists spray intelligently. They spray for definite purposes, with suitable materials, at proper times. Spraying will then improve the quality of the product and increase the yield. This is true of both fruits and vegetable crops (Fig. 50 and 51).

Spray Materials to Prevent Diseases.—Nearly all of the plant

diseases are caused by fungous growth. A few, however, are from bacteria attacks. The chief spray materials used to prevent disease are Bordeaux mixture, lime-sulfur, ammoniacal carbonate of copper, and livers of sulfur. The first two mentioned are more permanent and are not easily washed off by rains when once dry on the plants. The other two materials are used in cases where it is necessary to wash the fruit or other product before human consumption. They may be used to spray fruits that are nearly mature. Another fungicide is copper sulfate used on the dormant form of the plants. Lime-sulfur is also used to control scale insects, chiefly during the dormant season of the plants. Each of these will be discussed in this chapter.

Bordeaux mixture is made of three materials: copper sulfate, fresh lime, and water. The standard formula is 4 pounds of copper sulfate, 4 pounds of lime, in 50 gallons of water. This is briefly expressed as 4–4–50. The 3–4–50 formula is sometimes used where plants are tender, as on young tomato plants. In commercial orchards many growers make use of the 4–6–100 formula; just as good control of diseases is secured and the spray is less likely to do injury by burning or russeting the fruit and foliage.

Dissolve the copper sulfate in hot water or hang the crystals in a cloth in the water near the surface so that the dissolved part will settle to the bottom and let water not saturated come in contact with the crystals.

Slake the lime in cold water by pouring on a little water at a time until some heat is generated, then pour on enough water to keep it from burning or becoming dry from the heat. Do not smother the lime during the slaking process, or lumps will be formed. As the lime becomes completely slaked more water may be added, and the whole should be stirred vigorously for some time. When the mass is of a creamy consistency strain it through a cheesecloth or good type of strainer to remove grit and other particles which will not pass through a fine spray nozzle.

These two stock solutions may be kept separately for several weeks if evaporation is prevented. As they are used they should be thoroughly stirred or shaken before mixing.

Mixing Stock Solutions.—To prepare 100 gallons of Bordeaux according to the 4–6–100 formula, 4 gallons of the copper-sulfate stock solution and 6 gallons of the lime stock solution or 10 pounds of the hydrated lime made into a thin paste are required. Fill the spray tank about two-thirds full of water and start the agitator. Pour through the strainer the 4 gallons of copper-sulfate solution. Add the 6 gallons of lime solution or 10 pounds of hydrated-lime reduced to thin paste. Then add the required amount of arsenate of lead, usually 2 or 3 pounds, and enough water to bring the volume up to the required 100 gallons. The spray

should then be used at once for best results: Bordeaux deteriorates rapidly, and should be used as soon as possible after making. (Fig. 52.)

Lime-Sulfur.—This preparation is used abundantly in the control of San José scale, either as a winter spray or as a summer spray. The spores of fungous diseases are largely killed when this spray is applied. If orchard trees, for example, are sprayed with lime-sulfur during the winter the spores with which the spray comes in contact are killed. This

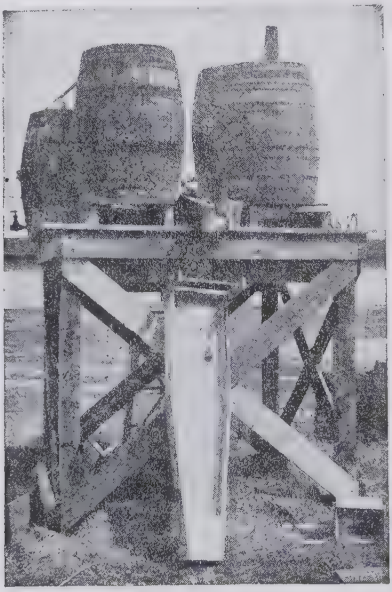


Fig. 52.—An elevated platform for mixing Bordeaux and other spray materials. Two barrels may be used for stock solutions and others for the dilute mixture. The extension trough aids in filling the spray tank, which is hauled near the platform. (Indiana Station.)

aids materially in the reduction of the disease during the following growing season.

There are several forms of lime-sulfur prepared, the home-boiled concentrated lime-sulfur, the commercial lime-sulfur, the self-boiled lime sulfur, and the commercial dry powder.

For spraying on a large scale home-made lime-sulfur may be prepared as follows. Use 38 pounds of fresh unslaked lime, 40 pounds of clean rolled sulfur powdered, and 50 gallons of water. Make a paste of the sulfur, using about 10 gallons of hot water. Then add the lime and let it

slake. Add more hot water as necessary to prevent drying or lumping. When the lime has all slaked add the balance of the water to make the 50 gallons and boil, stirring thoroughly while boiling, for one hour. As the water boils away, more should be added to maintain the quantity.

A good method of boiling is to have the water in a barrel or tank and heat with a hose or steam pipe from a small boiler. A simpler method is to put the materials in a large iron kettle over a fire. The red liquid may be poured into barrels and covered with oil to prevent evaporation in storage.

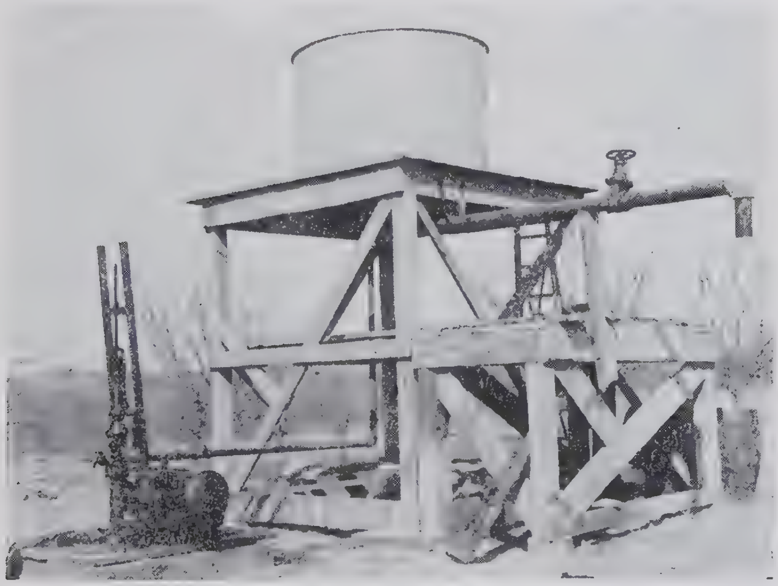


Fig. 53.—Deep well and elevated tank that supplies water rapidly and economically for spraying purposes. (Missouri Station.)

This concentrated solution must be diluted before using. For example, if the reading of the hydrometer is 35°, 1 part to 9 parts of water may be used for the winter spray for San José scale or as a winter fungicide. Twelve parts of water to one part of this same liquid will be right for the blister mite. One part of this strength of liquid to 45 parts of water would be strong enough for the summer spray on apples when the trees are in full leaf (see appendix tables for dilution).

Commercial Lime-Sulfur.—This is sold in concentrated form by a number of manufacturers. It is a clear amber or red liquid, and will test from 32 to 35 degrees on the Baumé hydrometer (Fig. 54). It is ready to

be mixed with water according to the proportions mentioned for the home-made preparation. With this and with powdered lime-sulfur come directions showing the dilutions for different purposes. (See Appendix tables.)

Self-boiled lime-sulfur is prepared by the heat formed in the slaking of the lime. Use eight pounds of good, fresh, unslaked lime. Add water to start the slaking gradually, but use sufficient to keep it from burning or lumping. When heat has begun to generate well, slowly sift into this eight pounds of the fine sulfur. Stir the mixture constantly and thoroughly. Add more water as needed. As soon as the boiling has ceased add the remainder of the cold water to make a mixture of 50 gallons. (This formula is written 8–8–50.) Agitate well. It is used as a special spray material against peach scab and brown rot of the stone fruits. Poison can be easily mixed with it for curculio, bud worms, and other chewing insects. In making this preparation the amount of boiling is variable. If hot water is used, the solution boils more. The stronger liquid may injure peach leaves. The mixture may also be varied by using a little more or a little less of the lime and sulfur in the 50 gallons of water.

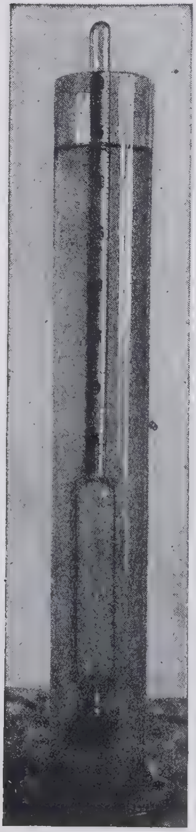


Fig. 54.—Hydrometer and cylinder for use in testing the density of lime-sulfur and other spray materials. It is scaled by the Baumé standard. See table in appendix. (Indiana Station.)

The use of poisons with a winter or summer spray of lime-sulfur is effective against chewing insects.

Dry-Mix Sulfur Lime.—This material is for summer work only and is used on stone fruits. Poisons mix with it either before or after wetting. The New Jersey formula contains very fine sulfur, 8 pounds; hydrated lime, 4 pounds; calcium caseinate spreader, 8 ounces; in water to make 50 gallons. Mix the three dry materials together uniformly, sifting through a medium sieve to pulverize lumps. Add water slowly to the mixture, stirring until the grains of sulfur are wet. Continue adding water to make 50 gallons. This should be strained into the spray tank.

Principles in Using Fungicides.—It is important to remember that all fungicides should be used before the disease breaks out. After a serious outbreak little effect can be seen from spraying (Fig. 55). Plants that have not yet been affected may usually be protected by spraying after neighboring plants are diseased. Use as strong a spray material as

possible without injury to the plants. Remember that young, succulent plants are more tender, and weaker solutions are necessary. A little trial will help to determine this point without depending absolutely upon formulas given in books or bulletins.

The principle involved in the use of fungicides is to use a material which is as permanent as possible without destroying the plant or any of its product or making it unfit for human use.

The spray must be strong enough and frequent enough to kill the spores of the disease before they enter the tissues of the plants. After they obtain a good foothold it is difficult to control their growth.

Special directions for fighting the different diseases are mentioned in the discussion of the different fruits and vegetable crops.

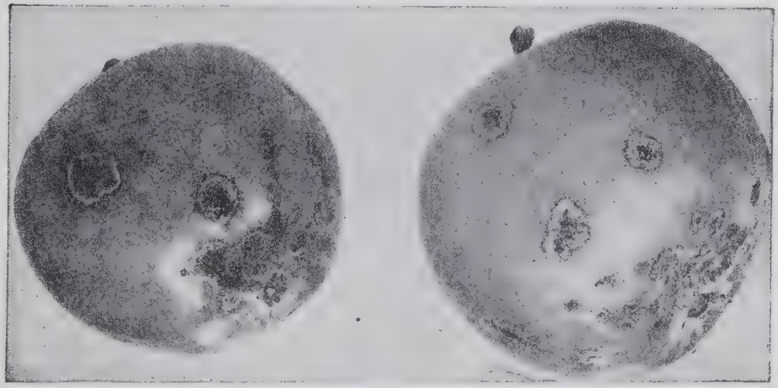


FIG. 55.—Apple scab is prevented by use of lime-sulfur as a winter spray, by the summer strength of lime-sulfur when the petals fall, and the same two weeks later.

To Fight Biting Insects.—Many insects live on the surface of plants, eating twigs, leaves, fruit, etc. They bite their food and also obtain some of the poison material which, if strong enough, will kill them. (Fig. 56).

Poison Sprays.—Arsenic is the chief ingredient of most of the poison sprays. It is used in many different forms. The chief forms are white arsenic, Paris green, London purple, arsenate of lead, and arsenite of zinc. Hellebore is a native poison made from the plant by that name.

White arsenic is probably the cheapest form in which arsenic is sold. It is a white powder readily soluble in water, but is very injurious to the foliage, and can seldom be used successfully on plants when they are in leaf.

Arsenate of Lead.—This form of arsenic is used abundantly on potatoes and orchard trees and for almost all purposes in fighting biting

insects. It is not so easily washed off the leaves by rains as are other forms of poison. Its composition is more uniform, and there is a smaller proportion of free arsenic present to injure the leaves. It is easily combined with the dilute forms of sulfur for summer sprays. It is sold in two forms, a thick paste and a powder. The dust is sometimes used to mix with air-slaked lime for dusting such plants as potatoes or low-growing vegetables. This is done in the morning when dew is on the plants. The lime helps dilute the arsenate of lead and causes it to cover more plants. It also

Fig. 56.—Canker worms feed on apple blossoms and on the leaves. Spray promptly with arsenate of lead. (Ohio Station.)

helps to hold the poison on the plants, as whitewash clings to a board fence. The use of molasses with such poisons causes insects to eat them more readily.

There are several strengths in which the arsenate of lead may be used, depending upon the insects to be killed, and also depending upon the danger of plants to injury. The rate is usually 1½ pounds of powder to 50 gallons, for apples and pears.

Arsenate of lime of good quality is much cheaper than the above and is used in about the same amounts. If used with lime or sprays containing lime, Bordeaux, or lime-sulfur, there is little danger of burning leaves. If used alone it may injure leaves somewhat. The powdered form

is used for dusting on potatoes, cabbage, cotton, corn, etc., when plants are moist with dew.

Arsenite of Zinc.—This was first used in the Pacific states and in the trucking regions of the Atlantic slope. It is a good substitute for arsenate of lead. If used with lime-sulfur or with Bordeaux mixture it is less injurious to the foliage. One pound of zinc arsenite is equivalent to about three pounds of arsenate of lead.

Hellebore.—The roots of white hellebore plants are ground into a powder which may be applied either dry or in a water solution. After being ground it loses its strength rapidly, and should be kept in a closed vessel to prevent deterioration. It may be dusted on plants in its full strength without injury. For the liquid spray use four ounces of powdered hellebore mixed with two to four gallons of water. An ounce of liquid glue added to this mixture will aid in keeping it on the plants.

Hellebore tea is sometimes made by boiling the roots in water. While fresh this may be sprayed on plants. Hellebore has its chief advantage in being much less poisonous than the arsenical preparations. It does not injure the leaves of plants and is less dangerous to crops that are to be used directly as human food.

Contact Insectides.—Among the contact insecticides are the soluble or miscible oils, lime-sulfur compounds, soap mixtures, resinous emulsions, kerosene emulsion, and crude-oil emulsion. Sulfur and nicotine sulfate may also be used as contact insecticides. Pyrethrum, tobacco dust, road dust, and other materials are sometimes used.

Kerosene emulsion is one of the oldest and one of the most effective home-made remedies for sucking insects. It is used commonly in fighting plant lice and all sucking insects with soft bodies.

Prepare a soap solution of kerosene emulsion by using laundry soap, one-half pound, two gallons kerosene, and one gallon of water. Shave the soap into the water while boiling hot. As soon as the soap is all dissolved remove from the fire and mix it with the two gallons of kerosene. Shake this mixture thoroughly for fifteen minutes. If you have a bucket pump use that in mixing, by spraying back into the same vessel. This soap solution may be kept in large bottles for use at any time. It should be shaken again each time before using.

On dormant trees and shrubs use one part of the soap solution to about seven parts of water. On plants in full leaf for plant lice, dilute it, using one part to about fifteen parts of water. Always make a trial to see if the plants are being injured, and also to see if the insects are being killed.

Home-Made Oil Emulsion.—Directions for making oil emulsion are practically the same as for making kerosene emulsion. The formula calls for one pound strong potash soap, one gallon water, and two gallons

good engine oil. The oil, soap, and water are placed in a vessel and heated until boiling begins. Just before this a brown scum appears. This will gradually disappear with the boiling. As soon as it has disappeared the heat should be cut off and the entire mixture pumped twice under pressure while very hot. The second pumping may be into storage receptacles. The entire contents should pass through a pressure pump twice. Use as a winter spray or when buds are swelling, mixing 8 gallons of emulsion with 100 gallons of water. This emulsion is less dangerous to plants than the kerosene emulsion, but a large amount of water may be used for either the dormant spray or the summer spray. Its effect in killing insects is greater because of the greater amount of grease in the crude oil.

The strength of the emulsion is often indicated by the per cent of oil or kerosene present in the diluted material; for example a two-per-cent emulsion would be indicated when three gallons of the above stock solution are mixed with 97 gallons of water.

Miscible Oils.—Soluble oils, or miscible oils, are prepared and are on the market for ready use in making spray materials. A number of companies prepare such oils from crude oils or distillates.

The chief use of the miscible oils is in fighting the San José scale, which is the worst of all sucking insects. For winter spraying against this insect use a two-per-cent solution. Usually directions come with each lot for making up the spray for different purposes and at different seasons. It is important to have the spraying done in dry weather and when there is little danger of freezing soon after spraying.

Soaps.—Fish-oil soaps have a disagreeable odor and are good repellants. They are often sold under the name of *whale-oil soap,* but there is probably little on the market made from whale oil. Strong soap of any kind when dissolved in water is good to use on tender plants for destroying plant lice and other soft-bodied sucking insects. Very strong soap suds should be used. Cottonseed oil and other cheap oils are used for making soaps to be used in spraying. A good formula for the home preparation of such soap is caustic soda, six pounds; fish oil or other oil, twenty-two pounds; water, one-half gallon. First dissolve the caustic soda in the water, then add the oil gradually while stirring vigorously. If this work is done in a warm place boiling will not be necessary. The longer the stirring is kept up the better the soap will remain in suspension.

Nicotine Sulfate.—This is an extract of tobacco containing about 40 per cent of pure nicotine sulfate. It can be combined with other sprays, as lime-sulfur, arsenate of lead, and soap solutions. It is well to always add some soap to the whole solution to help make it spread better over the plants.

A commercial form of this preparation is known as "black leaf 40."

This and the commercial nicotine sulfate are used in strengths varying from one part in 800 parts of water to twice that dilution.

Tobacco dust is used both as an insecticide and as a repellant. Dusting this on plants to repel insects may drive them away, or the nicotine extracted by the moisture of the dew or rain may kill some of the insects. Plant lice on the roots of apple trees or other plants are often destroyed by the use of tobacco dust. This is applied in the soil after digging away the earth from about the roots. Extract of tobacco stems is used in much the same way.

Lime-sulfur solution is one of the best insecticides for use against San José scale and other forms of scale insects. The coating formed over the surface of the bark seems to smother the scale insects and they are killed whenever the spraying is done thoroughly.

Directions for making lime-sulfur solutions have already been given. It may be applied in either the winter or the summer form according to the requirements; the strength is varied to suit the season.

Pyrethrum.—*Persian insect powder* is made from the heads of a plant belonging to the genus Pyrethrum, which we frequently find growing in gardens. It is a light brown powder which is somewhat dangerous to use in houses. It can be used if care is exercised not to breathe it. The powder loses its strength rapidly and must be kept in a closed vessel or used when freshly made. It is commonly used in the powder form, but may also be dissolved in water at the rate of one ounce to three gallons. In the dry form it may be mixed with other powders, such as lime dust, borax or flour. It may be used for fumigation by putting the powder on a shovel of hot coals.

Pyrethrum is sometimes dissolved in alcohol, one part to four parts of alcohol by weight. Shake this in a bottle and allow to stand for a week. This may be filtered through a cloth and used in an atomizer for house plants. Some water may be added if it is too strong for the plants. An extract of pyrethrum may be made somewhat in the manner of tea by pouring boiling water over the flower heads and allowing to stand for a few minutes.

Principles of Fighting Sucking Insects.—Remember that the spray materials must be strong enough to kill the insect by contact and must be applied when the insects are present. Oils and dust are both fairly good insecticides if they come in contact with the insects. Do not expect the insects to be killed unless the insecticide does the work when the insects are present.

Future attacks of the insects are not affected by spraying or dusting done in advance of an attack. Soft-bodied insects are much easier to kill by contact than are those of the scale group. Many of the so-called

eating insects would be killed by contact insecticides if their bodies were soft enough to be affected.

It is well understood by students that all insects breathe through special breathing pores located on the body, and not through the mouth. Smothering is believed to be at least a part of the cause of the death of insects killed by contact insecticides.

Spraying or dusting against sucking insects can not be carried on in advance, but the work must be done at the proper time. This should be early in the attack of any kind of insect. Do not wait until the plants are seriously injured before beginning to fight.

Job 16. Spraying

Conditions Usually Found.—(1) Spraying is more often neglected in home orchards than in commercial orchards. (2) Growers make many mistakes in pursuing a spraying campaign.

Aims.—(1) The use of different types of spraying equipment should be understood. (2) Spraying campaigns and methods of applying spray materials should be understood.

Problems for Study and Discussion

1. Find what sizes and types of sprayers are used in your region.
2. Compare sprayers with the sizes of orchards in the different cases.
3. What size of sprayer would you want for your orchard?
4. Study different types of spray nozzle and compare them for different materials.
5. Under what conditions would you want a spray tower on the spray wagon?
6. What are the advantages of having two lines of hose leading from the sprayer?
7. Ask orchardists how they manage to spray all sides of each tree most economically.
8. Find out the spraying campaign followed by the best orchardists.
9. Briefly give a spray calendar for apples and pears.

Activities.—(1) Make an annual spraying chart for apples and pears, showing in three columns time, material, and purpose. (2) Overhaul an old spray outfit and put it in condition for a season's work.

Special Ways of Fighting Insects.—Cut worms and other similar insects that eat plants are sometimes destroyed by poison bait. Bran mixed with Paris green or clover leaves dipped in some arsenical poison may be left where the insects may eat and be killed.

Grasshoppers are sometimes poisoned by the so-called "Criddle mixture." Mix one pound of Paris green with one barrel of horse droppings; add one pound of salt and some water so it will mix and spread nicely. Spread this well where the grasshoppers are abundant and where the poison will not do harm to birds or other creatures.

Kerosene torches are sometimes used for burning webs out of trees.

Lanterns burning at night over pans of water covered with kerosene form good traps for many insects. On warm summer nights the light attracts flying insects that fall into the kerosene and are killed.

Many insects are destroyed by hand picking and by pruning off parts on which they are feeding.

Banding of trees is sometimes used to trap the females of canker worm. This moth has no wings and must crawl up the tree to lay her eggs, where the larvæ are to find their food. A band of sticky fly paper will catch many of them.

Other trap bands such as brown paper or burlap are tied around the trunks of trees to trap codling moths and others that will form their cocoons under them. The bands may be removed and run through a wringer or burned to destroy the larvæ.

Barrel sprayers are of several kinds (Figs. 57 and 58). Those using a barrel without a head are most easily cleaned and usually to be

FIG. 57.

FIG. 58.

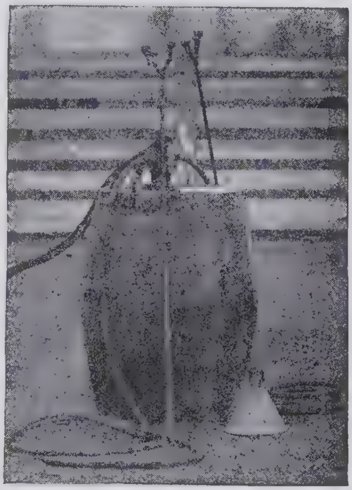


FIG. 57.—Using a barrel sprayer in a farm wagon. (Missouri Station.)

FIG. 58.—A common form of barrel pump with two leads of hose and two disk nozzles on each extension rod. The pump is bolted to the barrel head. This makes the barrel hard to clean out after using (New Jersey Station.)

preferred. Some form of agitator is usually connected with the lever so that the liquid is kept stirred constantly. These sprayers may be provided with either one or two lines of hose and connection rods. If barrel sprayers are used on wagons or sleds drawn by a horse the man operating the pump may also do the driving. An assistant is required for handling each line of hose and rod.

Tank sprayers of many sizes are used in large orchards (Fig. 59). The pumping may be either by hand or by engines of various kinds (Fig. 60). A suction hose leads from the tank to the pump and special agitators are usually required.

FIG. 59.—A double-acting hand pump and tank arranged to spray through two leads of hose from a farm wagon. From the tower platform the tops of orchard trees may be sprayed. (Indiana Station.)

FIG. 60.—With a gasoline or oil engine a high pressure may be easily maintained. This makes a fine mist. (Michigan Station.)

Time of Application	Materials to Use	For Control of
(1) Dormant or delayed dormant. Generally most satisfactory just as blossom buds are swelling in spring.	Lime-sulfur 14 gal., water to make 100 gal.; or cold or boiled lubricating oil emulsion 3 gal., water to make 100 gal.* Test 5° B.	San José scale and other scale insects. Winter spores of diseases.
Special spray. When buds are opening and aphid eggs are hatching, before blossoms open.	Oil emulsion 3 gal., water to make 100 gal.	Plant lice (aphids), San José scale.
(2) Cluster bud spray. When buds begin to separate but before they open.	Lime-sulfur 2 gal., arsenate of lead 2 lbs. water to make 100 gal.; or 4-6-100 Bordeaux arsenate of lead 2 lbs. (1° B.)†	Apple scab, leaf spot, curculio, canker worm.
(3) Second summer or calyx spray. Start when bloom is two-thirds off and finish before the blossom ends close.‡	Lime-sulfur 2 gal., arsenate of lead 2 lbs., water to make 100 gal. (1° B.)	Codling moth, plant lice (aphids), curculio, canker worm, apple scab, black rot, leaf spots.
(4) Third summer spray. Within 12 or 14 days after calyx spray.	Lime-sulfur 2 gal., arsenate of lead 2 lbs., water to make 100 gal. (1° B.) §	Apple blotch, curculio, codling moth, lesser apple worm, apple scab, leaf spot, phoma spot.
(5) Fourth summer spray. Twelve to 14 days after No. 4.	Lime-sulfur 2 gal., arsenate of lead 2 lbs., water to make 100 gal. (1° B.) §	Apple blotch, curculio, codling moth, lesser apple worm, apple scab, lead spot, phoma spot, sooty blotch.
(6) Fifth summer spray. Twelve to 14 days after No. 5.	Lime-sulfur 2 gal., arsenate of lead 2 lbs., water to make 100 gal. (1° B.) §	Apple blotch, curculio, codling moth, lesser apple worm, apple scab, leaf spot, phoma spot, sooty blotch, bitter rot.
(7) Sixth summer spray. Twelve to 14 days after No. 6.	Lime-sulfur 2 gal., arsenate of lead 2 lbs., water to make 100 gal. (1° B.) §	Apple blotch, curculio, codling moth, lesser apple worm, apple scab, leaf spot, phoma spot, sooty blotch, bitter rot.

* If purchased miscible oils are used, dilute as directed by the manufacturers.

† Add 1 to 1½ pints nicotine sulfate when aphids are serious.

‡ Most important summer spray. Should be completed within a week of when the first petals fall.

§Where apple blotch or phoma spot is serious, use 4–6–100 Bordeaux mixture instead of lime-sulfur.

Note.—Bordeaux is less likely to do injury to fruit and foliage at this period and at later applications. Where diseases and insects are not serious, sprays Nos. 2, 3, and 4 may be sufficient for the protection of the fruit and foliage. For the central and southern states, where codling moth, apple blotch and bitter rot are to be controlled, all the sprays may be needed with even one or two additional applications. Dry lime-sulfur, 5–7 lbs. to 100, may be substituted for the liquid. The dry product is not quite as effective for scab but is less injurious to fruit and foliage. Moreover, one of the milder sulfurs, such as flotation sulfur or bentonite sulfur, may be used in the place of lime-sulfur if it is believed that the risk from scab infections or from other fungous diseases is not great.

Gas sprayers may be used by orchardists. Gas tanks containing either condensed air, carbon dioxide, or liquid air are used in connection with spray tanks made air tight by screwing on tight covers after the spray material is placed in the tank. The gas tank is connected with the spray tank by a tight, metal-covered tube. The liquid is then forced out by gas pressure from the bottom of the spray tank through a pipe connected with the hose and extension rod.

A spray program is a convenient reminder and guide in fighting insects and preventing diseases. The accompanying table was prepared by the Minnesota Station, (Bulletin 153). In almost every case an insecticide should be combined with a fungicide to save labor and accomplish two purposes at once. The calendar suits all parts of the country, but will always need to be varied in some particulars to suit the season or conditions.

Fig. 61.—The large disk nozzle gives a finer mist than the older types. The angle connection, shown at the base, makes the spraying easier and more thorough. (Indiana Station.)

Elevated Towers.—Frequently trees are so high that the man using the spray rod needs to stand at a high elevation above the tank. Towers are then built on wagons holding the spray outfit. This plan makes it possible to reach the upper parts of the trees which might otherwise be missed.

Hose and Extension Rods.—The hose used in spraying should be strong and durable. On the other hand it should be easily handled and not too heavy.

Extension rods should be of lengths to suit the kind of spraying. For large trees, rods eight to twelve feet in length are sometimes used. At the base of the rod is a shut-off cock so that the operator in moving the rod from tree to tree, will not lose much material. The nozzle is attached to the end of the rod. Extension rods are usually made of thin brass surrounded by a bamboo tube. Sometimes they are merely sections of gas pipe made of galvanized or black iron. The inside diameter may be about one-fourth inch.

Nozzles.—Spray nozzles are of many types. They can be used in connection with any of the spray machines except the atomizer. Most sprays require that the liquid be made as fine as possible. Heavy streams of liquid are not usually desired. The best forms of nozzles now in use are those with large disk, sold as "disk nozzles" (Figs. 61 and 62).

The nozzle should be connected with the spray rod by means of a

45 degree elbow, so that by merely turning the rod the operator can easily give a different direction to the spray. He can thus more easily strike all sides of the leaves and stems of plants.

Dusting.—Dusting is frequently practised instead of spraying. It saves handling so much liquid and makes the work more rapid. Orchardists sometimes use power dusters for summer applications of insecticides and fungicides. Dusting, however, is yet in the experimental stage, and where insects and diseases are serious better results are likely to be secured through the use of liquid sprays.

Principles of Spraying.—Liquid sprays should usually be applied on a bright day to give the liquid time to dry before rain, although spraying work may be carried forward with good results until rain begins to fall. It is not necessary to respray the trees after a rain as some spray is not washed off readily. Begin where the work stopped as soon as the foliage and fruit are dry. If the spray is properly applied it should be effective.

FIG. 62.—Several types of spray nozzles. All modern nozzles have a large disk in which the liquid is given a rotary motion before exit from the orifice. (New Jersey Station.)

The finer the mist formed in spraying, the more even will be the spray on the surface of the plants. Damage to the plant is less likely to result (Fig. 63).

Always make the spraying very thorough. Do not allow any part of the plant to be missed (Fig. 64). Insects feeding upon the parts not sprayed may afterward spread to other parts of the orchard or garden.

Never spray unless you know for what you are spraying. Use the material required for the purpose in hand.

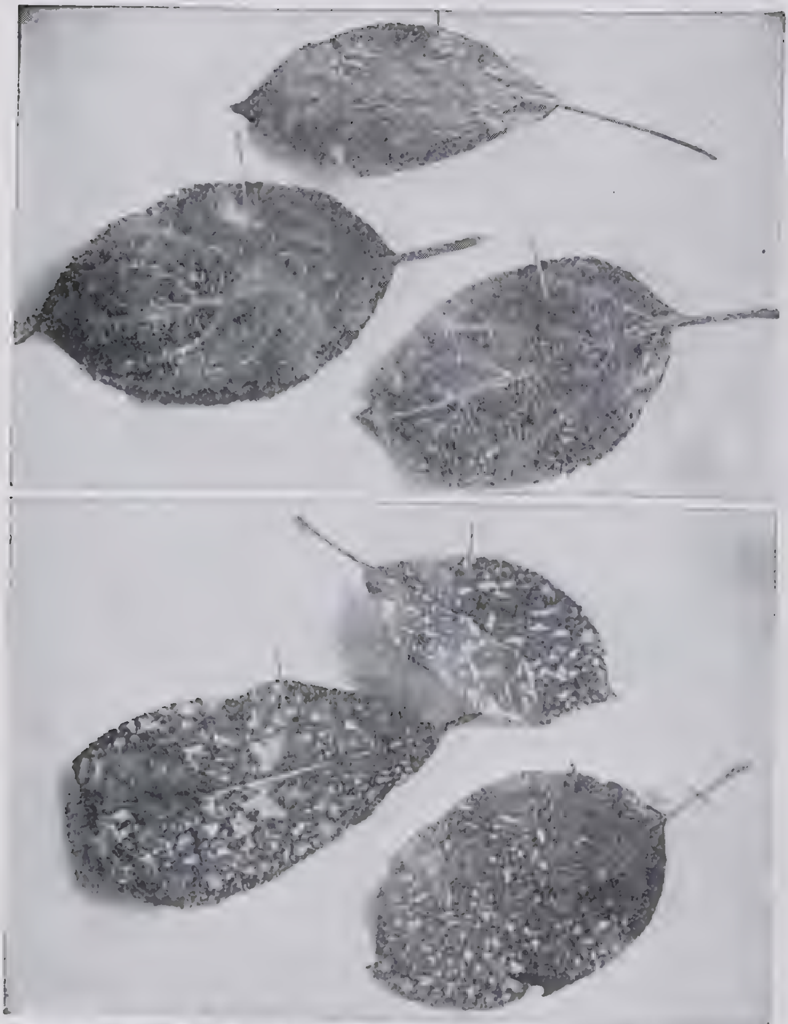


FIG. 63.—Upper figure shows an even coating of spray material from fine nozzle and high pressure. Lower figure shows the poor work of a coarse nozzle or low pressure. (Kansas Station.)

Never drench the plants unduly. Damage is likely to result and material is wasted.

Fig. 64.—A Maryland orchard thoroughly sprayed with lime-sulfur. Every spot is coated with the spray material to smother the scale insects and to destroy spores of all diseases. (U. S. D. A.)

The cost of spraying is largely governed by the labor involved. If the spraying apparatus is handy and the work is begun promptly, the benefits will usually far exceed the cost of labor and material (Fig. 65).

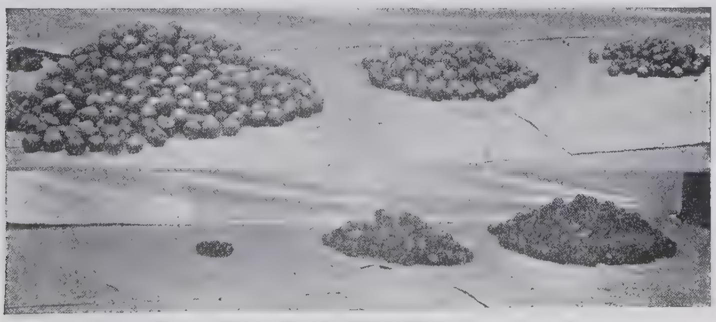


Fig. 65.—Spraying the apple orchard pays. Upper lot from tree sprayed three times; fruit mostly No. 1, at left, few culls at right. Lower lot from tree not sprayed, fruit mostly culls at right. (Illinois Station.)

Avoid making the spraying irksome. Protect your hands and face with suitable materials to avoid injury to the skin. Rub a little vaseline

upon the hands and face before spraying with Bordeaux mixture and the material is easily washed off.

Poison sprays should be handled cautiously and not be left where children or dumb animals may be injured.

Job 17. Renovating Old Orchards

Conditions Usually Found.—(1) In many regions old home orchards long neglected may be made productive by modern methods. (2) New owners often encounter such problems.

Aims.—(1) Students should be able to decide what factors to use in renovating an orchard. (2) They should know how much to prune, cultivate, fertilize, and spray to produce economic results.

Problems for Study and Discussion

1. Locate orchards in your region which need renovating.
2. Give examples if possible of orchards which have been renovated successfully.
3. Give the arguments for and against replanting trees where others have died.
4. How can you decide when to renovate, and when to destroy old trees?

FIG. 66.—An old Baldwin orchard after being rejuvenated by pruning, spraying, cultivating and fertilizing. (Courtesy of F. C. Sears.)

5. Compare renovating pear orchards with renovating apple orchards.
6. What are the bad effects of too heavy pruning of old trees?
7. What may be the bad effects of plowing a long-neglected orchard?
8. When trees are caused to grow too much new wood each year, what is the effect on fruit production? Show the relation of this to proper fertilization.
9. What extra spraying may be necessary in a neglected orchard?

Activities.—(1) Compare yields from old with yields from renovated orchards. (2) Students should conduct projects in renovating home orchards.

Renovating Old Orchards.—On many farms there are old orchards of apples and other fruits that should be renovated. If the trees are not too nearly dead, and if enough of them are still standing to fill the area fairly well, they may warrant some work and expense of renovating (Fig. 66).

Steps in Renovation.—Four or five steps are necessary in reviving an old neglected orchard.

1. Pruning is always necessary, but there is danger in pruning too heavily at one time, for it may cause a very rank growth of new wood and thus delay the bearing of fruit for some years. No harm can come from cutting away all the dead or unhealthy parts (Fig. 67). Beyond this do not thin the limbs too much.

2. Cultivate the soil by plowing shallow at first and deeper afterward. In orchards where such tillage is possible the effects will be very beneficial.

Fig. 67.—A lesson in rejuvenating an old apple tree. Such work is necessary only after much neglect. (New Jersey Station.)

3. Fertilizing the soil to feed the trees must be done with judgment. Use considerable stable manure or nitrogenous fertilizer if the growth of leaves and new wood shows lack of vigor. If this growth is likely to be sufficiently stimulated by pruning and cultivation, omit most of the nitrogen but feed the trees with phosphate and potash.

4. Spraying is always necessary in a neglected orchard. Follow a good annual spraying campaign as given in Job 16.

5. Working over the trees to change the variety to a more valuable kind is sometimes advisable. This takes more time and delays the results longer than the four preceding operations. (Figures 68 and 69).

Cleft-Grafting.—This form of grafting is usually performed in

the tops of trees but may be used nearer the surface of the ground. Branches one-half inch in diameter or larger are cut across and split with a heavy knife or chisel. Two wedge-shaped scions are cut and inserted at the edges of the split twig in such a way as to bring one cambium layer of each in contact with the cambium layer of the cleft branch. The wound is then thoroughly waxed with rather hard grafting wax to exclude rain and prevent drying-out. (Fig. 68.)

Top-Working Fruit Trees.—There are several reasons for desiring to top-work fruit trees.

1. The grower sometimes finds that the variety he has does not suit his purpose.

Fig. 68. Fig. 69.

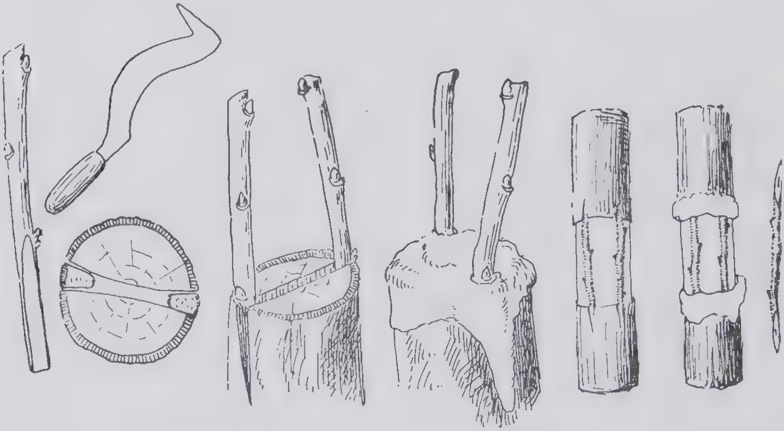


Fig. 68.—Cleft-grafting. Scions are cut beveled both ways as shown at the left, so as to fit closely at the cambium and inner bark. The tool or cleaver shown is used to split the stock. Grafting wax is used to protect all the wounds as shown at the right.

Fig. 69.—When trees are girdled by mice, rabbits, or farm implements, they are sometimes saved by bridge-grafting. Two stages of the process are here shown.

2. He may find the variety is not the kind he supposed he was purchasing when the trees were obtained from the nursery. Labels are often misplaced and mistakes are liable to occur.

3. He may desire to insert a new kind on the tree which is already in bearing. He may then place a new variety on one or more of the limbs to test quickly a new kind, as it will bear earlier than if started on a young tree.

4. If he has a large block of trees of one variety that have proved to be self-sterile, he may be getting plenty of blossoms with little or no fruit. He may then find it advisable to top-graft a number of trees in

the block with another variety which blossoms at the same season. The two kinds will furnish pollen to each other and fruit will be produced.

5. Young orchards are sometimes set with well known varieties. The next year these may be top-grafted or top-budded with scions taken from the owner's orchard of bearing trees. The orchardist thus gets buds started which he is absolutely sure are true to name. He also has saved something on the purchase of his trees by selecting cheap varieties from nursery catalogs.

Top-Working by Cleft-Grafting.—If apple trees are top-worked for any of the above reasons, the method used may be either cleft-graft-

Fig. 70.—Two steps in working over an old apple tree by cleft-grafting scions of a better variety. The success of this work depends upon an even growth and good union of the woods of stocks and scions. Budding on smaller twigs is more successful.

ing or budding. If the cleft-grafting method is to be used scions of the desired varieties may be saved from the preceding dormant season by storing them in damp sawdust in a cool cellar. These may then be inserted in the spring after growth has started, or a little before that. Care must be used to prune away competing branches and allow the new graft to have room, light, and air for growth. After the new grafts are well established more pruning away of the old sort may be done. (Fig. 70.)

Budding of Old Trees.—Many orchardists find much difficulty in top-grafting old trees. The stocks and scions may fail to grow uniformly in size or the union may be incomplete, particularly in the heart

wood. The result of an incomplete union may cause breakage during wind storms. For these reasons budding is quite commonly practised in top-working orchards, whether the trees be young or old. When a shield bud is inserted on the side of the stock, the unevenness of growth will make no perceptible difference. As little or no wood is present under the bark, there will be no weakness to cause trouble in the future.

There is one serious difficulty, however, in top-working orchard trees by the budding method. A single bud is inserted in each place and much more work is required to insert a sufficient number of buds than by the cleft-grafting or tongue-grafting method.

Top-budding of orchard trees may be practised with practically all kinds of orchard fruits. The work may be done at any time during the growing season provided buds suited for the season are available. If the work is done in the spring or the early summer, dormant buds held over from the winter season are used. If the budding is to be done late in the summer or early fall, buds of the current year's growth may be inserted and allowed to start into growth the following spring. Practically no time is gained by the fall method, and it is less common.

Replanting Trees.—When a tree has died from old age, because of poor soil where they are growing, or from disease, the orchardist is in doubt whether or not to plant another tree in its place. The spot may be infested with nematodes, woolly aphis, root rot, or other troubles. The soil may be too poor to grow a tree successfully. The owner should study the situation carefully and find the cause of death of the former tree. There is no objection to planting a new tree in an old place if the old tree died from injury or from some disease or insect which does not infect the soil.

Job 18. Protecting Against Frost

(See peach enterprise.)

Job 19. Harvesting the Fruit

Conditions Usually Found.—(1) Fruit from home orchards is often carelessly harvested. (2) Commercial growers usually practise good methods.

Aims.—(1) Students should learn the stages for picking each of the varieties grown. (2) They should learn good methods of picking and what containers to use.

Problems for Study and Discussion

1. Ask local growers how they determine the maturity of each of the varieties, for home and for market.
2. What differences are made when fruits are to be shipped long distances?
3. Ask successful growers just how they handle fruits when picking.
4. Compare different kinds of containers used by pickers.
5. Describe the baskets, boxes, and crates used in preparing apples and pears for market.

6. How are tree limbs supported before and during picking?
7. What types of trucks or wagons are used in hauling fruit from the orchard?
8. Describe good picking ladders.
9. Ask growers what differences they find in varieties of apples regarding injury during picking. Same for pears.
10. At what stage of maturity are pears usually picked?
11. Why should some varieties of pears be ripened in the dark?

Activities.—(1) Make ladders and holders for picking baskets, and make up apple boxes and barrels. (2) Enter contests in picking fruit, to gain skill.

Equipment for Harvesting.—Ladders having the two legs far apart at the base and having only one standard at the top are suitable for leaning against the tree while picking apples and pears.

Picking receptacles should be as firm as would be needed in carrying eggs from the hen house. Wooden or metal buckets are better than bags, as the fruit is less injured. Containers for the fruit may be such as are to be sent to market, or may be temporary containers such as boxes and barrels, available on any farm. When fruit is to be sorted at a packing center, temporary containers may be used. Trucks and wagons for hauling fruit from the orchard should be low to facilitate loading and unloading.

Judging Maturity.—Summer apples are often picked prematurely, because there is always a demand in the market for green apples at that season. When ripe fruit is desired, the grower must judge the degree of ripeness to suit each variety and to suit the time required to get the fruit to market. For long shipments fruit may be picked earlier than for local markets.

Pears are often picked prematurely and ripened in the dark. They are of better texture, less gritty, and of better flavor if this plan is followed. This is most important for dessert varieties, and it improves the quality for cooking pears.

Fall and winter varieties of apples are usually left on the tree until rather mature. Varieties with tender flesh and varieties which handle badly must be picked in a more immature condition than others.

Picking.—Too often the fruit is allowed to drop to the ground and is gathered after it has been injured by falling. On the market windfall fruits are considered as culls and are hardly worth handling. They are so badly bruised that they will not keep long, and the bruised side at least has to be wasted by the consumer. The rot started by the bruising soon destroys the whole fruit.

Pick fruits from the tree when they are nearly mature, and keep them in suitable places until used or sold. A good plan for picking is to use a half-bushel basket with strong, rigid handles which can be suspended on the left arm or hung from a hook on the ladder. This basket should be lined with a heavy bag or cloth. As fast as the basket is

filled the picker descends to the ground and carefully transfers the fruit to boxes or barrels. Fruit should be removed from the tree by grasping it firmly and giving it a twist and quick side movement, breaking it from the woody twig at the proper point. It is also very important that the fruit be rushed to clean cool storage as soon after picking as possible. More deterioration or decay may occur in a few days under the apple trees on the ground than in several months in good common storage or cold storage.

Job 20. Storing Fruits

Conditions Usually Found.—(1) Apples, and sometimes pears, are often stored at home for winter use or for sale at better prices later. (2) Commercial growers often find storage of fruit profitable.

Aims.—(1) Students should learn to consider all factors involved in the economical storage of fruit. (2) They should learn good methods of storage, for home use and for market purposes.

Problems for Study and Discussion

1. How are fruits stored for home use in your region?
2. How successful or how wasteful do farmers find this practice?
3. What commercial growers do or do not store fruit in your region? Give their reasons.
4. Describe a good underground store-room for apples.
5. Describe a good storage house above ground.
6. Compare prices at harvest time with prices when stored fruits are marketed.
7. What effect does the practice of storing fruit have upon these prices at both times?
8. Find the cost of keeping barrels of apples in cold storage at your nearest cold-storage plant.

Activities.—(1) Visit several fruit-storage houses and note their arrangement. (2) Draw plans for a storage house, improving, if possible, on those you have seen.

Storing for Home Use.—Fall and winter apples and sometimes pears are kept for several weeks or months for use in the home. The surplus is frequently sold in local markets. Winter varieties are always better keepers than fall varieties.

One of the best home storage places is a cellar where the fruit will neither freeze nor dry out too much. The apples may be placed in barrels or boxes, closed up tightly, and placed in the cellar until needed for market or for use.

Cold-storage plants are sometimes utilized for the keeping of apples and pears either for home use or for market. Rental rates at a cold-storage plant are usually low enough to warrant the keeping of fruits for sale at a later date.

Apple Storage Houses.—There are two chief types of storage houses for apples: (1) those built above ground with double walls and shutters on the windows; (2) those mostly underground or built in a hillside with ventilators at the top.

The apple storehouse should be located where it will be handy either to the orchard or to the place where fruit is to be loaded into cars for shipment. Apples will keep well in storehouses which are properly built, and the shrinkage from rotting should be very little. The temperature of the storage rooms should be as nearly thirty-two degrees as possible without allowing the fruit to freeze. Apples may be kept for several weeks or months if the temperature is properly regulated.

Job 21. Grading and Packing Fruit

Conditions Usually Found.—(1) Commercial growers usually realize the value of very careful grading and packing. (2) In local markets, and to some extent in large markets, much poorly graded and poorly packed fruit is found.

Aims.—(1) Students should learn the market grades of each type of fruit. (2) They should learn kinds of packages and how to pack each.

Problems for Study and Discussion

1. What types of baskets, boxes, or crates are used for apples and pears in your region?
2. What are the requirements in your state regarding the labeling of fruit packages for market?
3. Into what sizes are apples graded?
4. What other factors help determine grades No. 1; No. 2; and No. 3?
5. Where would you locate a packing shed for your orchard?
6. Would you prefer to do the grading near the orchard or near the railroad station if shipping fruit in carload lots?
7. Give the points for and against machine graders.
8. What do local growers do with the culls after grading?

Activities.—(1) Students should have much practice in grading and packing fruit for market. (2) Speed in wrapping and boxing apples may be attained through contests.

Containers.—Bushel baskets with splint covers are often used for early summer apples from southern regions. Standard bushel boxes are largely used for apples of the best grades from western regions. This type of container is gaining in popularity elsewhere. Standard apple barrels are abundantly used in eastern apple-growing regions.

Labeling Containers.—Laws in a number of states require that closed packages of any kind shall be labeled with the true variety and name of the grade of fruit contained in it. When fruit is packed under inspection these labels are stamped in letters of legal size on each package.

Grades of Apples.—The different grades of apples are designated by laws or state regulations and vary for different sections of the country. Western states recognize Extra Fancy, Fancy, and Choice. Many states farther east use the numbers 1, 2, and 3.

The highest grade usually means fruit which is sound, smooth, and free from worms, worm stings, scale, water core, sun damage or diseases of any kind. They must be of proper shape for the variety. Apples

smaller than 165 to the box shall not be included in this grade. The color must be true to the variety.

The second, or Fancy, grade must conform to the above requirements except that apples of the smaller varieties may range as high as 200 to the box. (Fig. 71.)

Grade C, or No. 3, includes all marketable apples below the above grades. They must still be sound and free from bruises, blemishes, stings, and diseases. They must be of proper shape and the skin must be unbroken. The color may vary more than in other grades. Nothing smaller than 200 to the box can be included.

Fig. 71.—Fancy apples are often packed in boxes holding almost one bushel. The "3–4" pack here shown is used only for small apples The "2–3" is more common. Wrapping prevents bruising and makes the fruit keep longer.

Barreled apples are generally less closely graded than boxed apples, though in some sections they are graded almost as closely as any.

Preventing Culls.—The Michigan Station found that 50 per cent of the commercial-grown apples are culls or B-grade. When A-grade fruit sold for \$1.31 per bushel, C-grade sold for 21 cents and B-grade sold for 88 cents. The lower grades can be brought up to A-grade, and this can be done with profit in most cases. The factors which cause cull fruit (Fig. 72) are almost completely within the grower's control.

A Packing House.—Coöperative associations often have large packing houses for handling the apple crop. Any packing house, whether it be large or small, should be located at a convenient place for final

loading. If the fruit is to be packed on the farm, a packing shed may be near the other buildings where the fruit can be easily loaded on the trucks for hauling to the cars.

Machine graders of several sizes are commonly used for apples. The shape of pears interferes with the use of machine graders. Large ma-

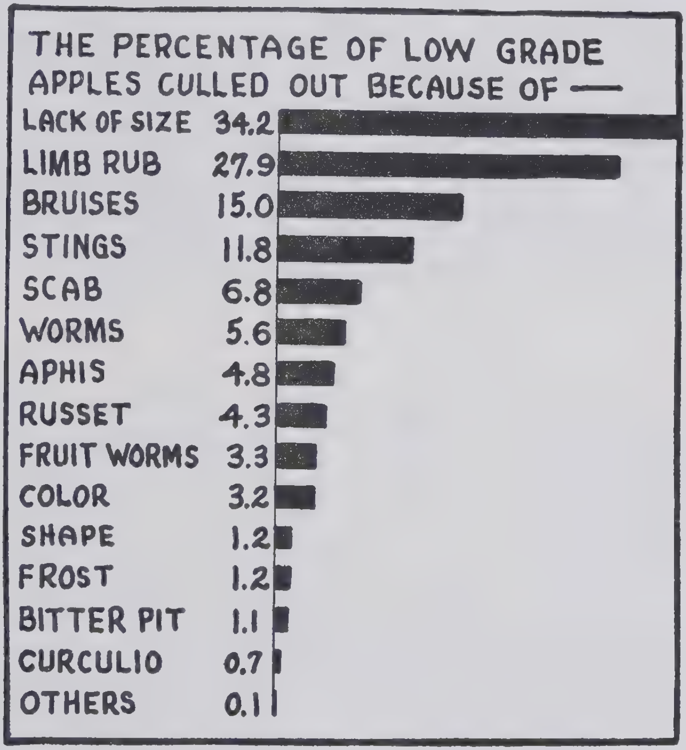


FIG. 72.—The factors directly responsible for low-grade fruit.

chines are used in the large packing houses. Some of them grade by size and some by weight of each fruit. Smaller machines grade by size only and are operated either by foot power or by hand. Machine graders usually give good satisfaction.

When fruit has been stored it should be regraded before shipment. (Fig. 73.) It is seldom graded when put into storage. Blemishes or bruises which did not appear at first may show after storage and cause some fruit to rot.

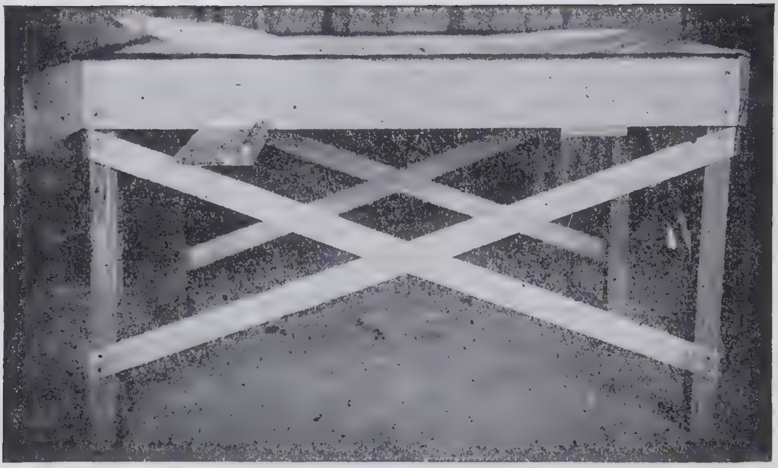


Fig. 73.—A convenient packing table with loose burlap bag top, used in sorting fruit and packing boxes. (Indiana Station.)

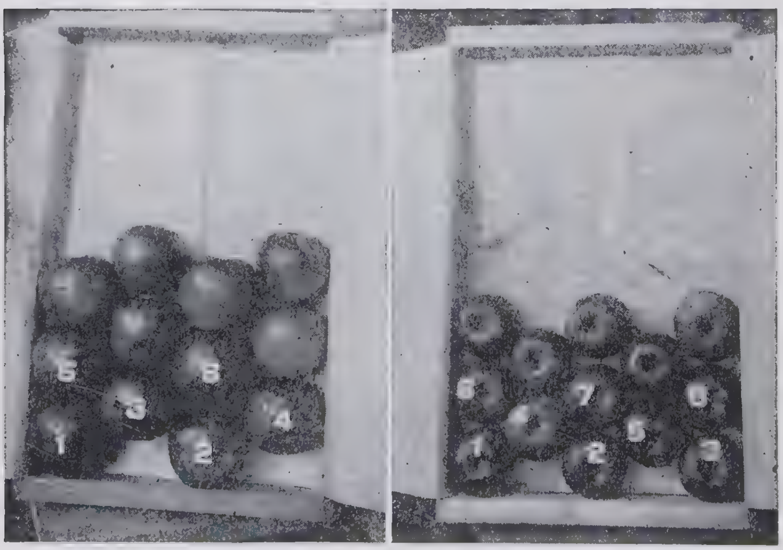


Fig. 74.—Two methods of packing apples in boxes. At left, start of 2–2 diagonal pack. The box holds four layers of 24 apples each. At right, start of 3–2 diagonal pack, with smaller apples. The box holds five layers of 33 apples each. They are placed in layers in the order in which they are here numbered. (Indiana Station.)

Guide for Box Packing of Apples.—Apples are usually packed in boxes with the stems down, until the top layer is reached, when they should be packed stem end up. When the cheek pack is used with the apples on their sides the core line may be parallel to the box side or diagonal to it. Apples are never packed crosswise of the box or with the core line at right angles to the box side. (Fig. 74.)

When the sizing and grading for box packing have been done and the fruit is ready to be packed, the following table will be found helpful in deciding what pack to use. The completed box should be stenciled on one end with (a) the name and address of the packer, (b) the variety and grade of apples, (c) the tier and number of contained fruits. (Indiana Station.)

Approximate Lateral Circumference of Apple	Style of Pack	Number Apples per Box	Layers and Number in Each	Number in First and Second Rows	Box Marked
A 12 inches	Straight 3	45	3 x 15	5–5	3 tier
B	Straight 3	54	3 x 18	6–6	3 "
C 11½ "	2–2 Diagonal	56	4 x 14	4–3	3½ "
D	Straight 3	63	3 x 21	7–7	3 "
E 11 "	2–2 Diagonal	64	4 x 16	4–4	3½ "
F 10¾ "	2–2 Diagonal	72	4 x 18	5–4	3½ "
G 10½ "	2–2 Diagonal	80	4 x 20	5–5	3½ "
H 10 "	2–2 Diagonal	88	4 x 22	6–5	3½ "
J 9⅞ "	2–2 Diagonal	96	4 x 24	6–6	3½ "
K 9¾ "	2–2 Diagonal	104	4 x 26	7–6	3½ "
L 9½ "	3–2 Diagonal	113	3 x 23 2 x 22	5–4	4½ "
M 9 "	Straight 4	96	4 x 24	6–6	4 "
N	Straight 4	112	4 x 28	7–7	4 "
O	3–2 Diagonal	125	5 x 25	5–5	4½ "
Q	3–2 Diagonal	138	3 x 28 2 x 27	6–5	4½ "
R 8⅞ "	4–4 Offset	140	5 x 28		4½ "
S 8½ "	3–2 Diagonal	150	5 x 30	6–6	4½ "
T	3–2 Diagonal	163	3 x 33 2 x 32	7–6	4½ "
U 8 "	3–2 Diagonal	175	5 x 35	7–7	4½ "
W	3–2 Diagonal	188	3 x 38 2 x 37	8–7	4½ "
X 7½ "	Straight 5	200	5 x 40	8–8	5 "
Y	Straight 5	225	5 x 45	9–9	5 "

Job 22. Marketing and Using Fruit

Conditions Usually Found.—(1) Much marketing is haphazard and not coöperative. (2) Systematic marketing by commercial growers, either alone or in coöperation with others, is usually most profitable.

Aims.—(1) Students should learn good methods of marketing. (2) They should know the advantages of coöperating with others in marketing.

Problems for Study and Discussion

1. What local growers plan in advance for marketing their fruit crop?
2. Who among these sell their fruit to a local market and who ship to distant markets?
3. Compare their results.
4. Do those who sell locally plan or wish to ship their fruit? Why?
5. Compare marketing of summer and winter varieties.
6. Could a coöperative marketing association be formed in your region? Why?
7. Ask fruit growers what advantages would come from:
   (*a*) Buying crates or baskets together.
   (*b*) Hiring a manager to locate markets and sell fruit.
   (*c*) Arranging for bidders to buy fruit at the railroad station.
   (*d*) Arranging for cold storage or other storage in holding fruit.
   (*e*) Securing cars and arranging for shipping facilities.
   (*f*) Providing capital with which to harvest and market the crop.
8. Tell how to make and preserve sweet cider.
9. Describe the making of cider vinegar.
10. Learn from a cook book how to make apple butter.

Activities.—(1) Make many notes on observations on a trip through a good fruit market. (2) Practise making apple cider. (3) Introduce mother of vinegar to apple cider and note the length of time required for it to turn to vinegar.

Suiting the Market.—Some markets do not favor certain varieties, while others are partial to them. The grower should try to find markets which demand his product. Fruit intended for market should be prepared according to the standards found there. If boxes, baskets, or barrels are preferred, fruit should always be packed accordingly.

Some growers find local markets more suitable than distant ones. They may have created their own markets by advertising or by educating the buying public to suit their own product. It may be expensive to try to change the standards of a market to suit special conditions which the grower desires, but slight changes may be accomplished with little trouble if markets are not too large.

Finding a Market.—The greatest problem in finding a market for fruit is concerned with quantity and not quality only. For each kind of fruit the grower should try to locate a market which is not overstocked. Any shipment reaching a crowded market is likely to sell at a loss. Much expense may be involved in telegraphing and telephoning to determine the market conditions in different centers. Shippers sometimes send their fruit to crowded markets when others not far distant are demanding more fruit. Such mistakes should be avoided if possible.

Summer and Winter Varieties.—Marketing of summer apples presents many problems not involved in the selling of fall and winter

varieties. The fruit is more perishable. Cars may need to be iced. A small quantity is more likely to supply the demand. Other kinds of fruit are competing.

Winter varieties, if stored or held until freezing time, may be injured by freezing during shipment. Dealers are willing to handle larger quantities of winter apples, as they are usually good keepers. Prices are more stable and there is less risk of loss from price fluctuation.

A Coöperative Association.—Commodity marketing started in the fruit business. This form of marketing is growing rapidly in many sections of the country. (Fig. 75.) There are several advantages in selling through a coöperative association. (1) Suitable markets may be located with less expense to each grower. (2) Grading and packing may

Fig. 75.—In coöperative fruit-shipping associations the sorting and packing is often done on an extensive scale at a central station. (Photo by T. Gagnon.)

be better standardized. (3) The requirements of certain markets may be more readily met. (4) Arrangements for buyers to take the crop at the railroad station are more easily made. (5) Storage, when necessary, may be more readily secured. (6) Cars and other shipping facilities may be obtained with less uncertainty. (7) Supplies, such as containers, spray materials, and fertilizers may be secured at better rates. (8) Labor for harvesting and packing is often supplied through an association. (9) The experience and judgment of a better manager may be secured. (10) Capital with which to harvest the crop may be supplied at lower rates.

Using Cull Fruits.—Much fruit not suitable for market may be made into sweet cider, which may be sold either wholesale or retail. If there is not a good market for sweet cider, much of this product may be made into cider vinegar by placing some mother of vinegar in the barrels of cider.

Apple butter, apple jelly, and dried apples are well-known products which may be made from cull apples. A small, select market for such home-made products, in fancy packages, may easily be worked up.

Commercial pectin is made from apple cores and parings and from cull apples.

Roadside Markets.—Apples and apple products as well as other horticultural and farm products are frequently sold at roadside stands maintained by enterprising growers.

Job 23. Keeping Financial Accounts

Conditions Usually Found.—(1) Growers of home orchards seldom keep any records. (2) Commercial growers usually keep careful accounts and study financial returns.

Aim.—Students should learn to keep orchard accounts.

Problems for Study and Discussion

1. Inquire in your region what farmers keep orchard accounts.
2. What special forms, if any, are used?
3. What arguments for and against record-keeping do growers give?
4. Obtain a form for keeping a record of hired labor, self-labor, and horse labor for this enterprise.
5. Make a list of miscellaneous expenses and materials, the amount and cost of which should be kept each year. Enter these on a suitable form.
6. Make a form which would aid in keeping the sales records.
7. What is meant by gross returns? Net returns?
8. What is meant by cost of production?
9. What is meant by labor income?

Labor Record.—In any fruit enterprise a suitable form should be ruled for recording the date, kind of work, and a column should be left for each of the kinds of labor—self-labor, hired labor, and horse labor. Such a form is here shown.

Date	Kind of Work	Self		Others		Horse		Tractor	
		Hours	Cost	Hours	Cost	Hours	Cost	Hours	Cost
Total Expense									

Miscellaneous-Expense Record.—A form should be drawn for keeping a record of all purchases and miscellaneous expenses each year. This will include such items as fertilizer, spray materials, purchase of

containers, trees, land rent, interest, insurance, repairs, deterioration, and use of buildings. A sample is here shown.

Date	Item	Quantity	Price per Unit	Cost

Sales Record.—Sales of fruit or any of its products should be recorded on a suitable form, such as is here shown.

Date	Item	Quantity	Price per Unit	Value Received

CHAPTER III

PEACH, PLUM, AND CHERRY ENTERPRISES

Collaborator, M. A. Blake, B.S., Professor of Horticulture, New Jersey College of Agriculture

Analysis into Jobs.—These three stone fruits are managed in similar ways. The operative and managerial jobs are suggested in the following list. The references are to U. S. Farmers' Bulletins.

1. Determining possibilities with peaches, plums, or cherries, 482, 727, 776, 917, 1001, 1360, 1372.
2. Propagating the trees, 702, 918, 1369, 1397, 1567.
3. Choosing the kinds and varieties to grow, 918.
4. Locating the site, 917, 1372, 1405.
5. Buying trees and receiving shipment, 157.
6. Preparing the soil, 1142, 1250.
7. Laying out the site, digging holes, and planting, 917.
8. Growing intercrops and cultivating the orchard, 279, 917, 945, 1307, 1518, 1750.
9. Providing plant food.
10. Pruning trees and thinning fruit, 181.
11. Controlling diseases, 1053, 1410, 1435, 1527.
12. Controlling insects, 650, 662, 723, 1128, 1246, 1557, 1676.
13. Spraying, 440, 908, 1285, 1666.
14. Protecting against frost, 1588.
15. Harvesting, grading, and packing fruit, 1266, 1702.
16. Marketing and using fruits, 900, 984, 1144, 1471, 1551, 1762.
17. Keeping records, 511, 572, 782, 1182.

Job 1. Determining Possibilities with Peaches, Plums, or Cherries

Conditions Usually Found.—(1) Orchards of stone fruits are less common in northern and central latitudes than apple orchards. (2) A few peaches, plums, or cherries are often included in home orchards. (3) Very large commercial orchards are commonly found in special regions.

Aims.—(1) Young orchardists should understand suitable regions, climates, and soils for these crops. (2) They should study the amount of labor and capital required and the dangers from insects and diseases. (3) Market possibilities should be understood.

Problems for Study and Discussion

1. What soils are best for stone fruits?
2. What regions are best for peaches and other stone fruits?
3. Discuss the influence of large bodies of water on climate for these fruits.
4. Where are cherries and plums mostly grown?
5. Ask local growers regarding the advisability of attempting to grow peaches, plums, or cherries.

6. What are the best markets for surplus fruit grown in your region?
7. What were the prices received for each of these fruits the last season?
8. What is the annual labor in caring for a bearing orchard?
9. How many trees of these kinds have been killed in local orchards by borers and San José scale?
10. How much of the fruit grown in your region is free from worms?
11. How much time is required to bring each of these fruits to bearing age?
1 . How much capital per acre would be required to care for the orchard until bearing age?
13. What allowance should be made for other crops grown between the young trees?
14. Consult growers regarding the dangers of overproduction of fruit.
15. Summarize your reasons for and against growing these orchard fruits.

Popularity.—The peach is probably the most popular orchard fruit in America, and yet the regions where it is grown commercially are much more limited than for the apple (Fig. 76). The largest peach or-

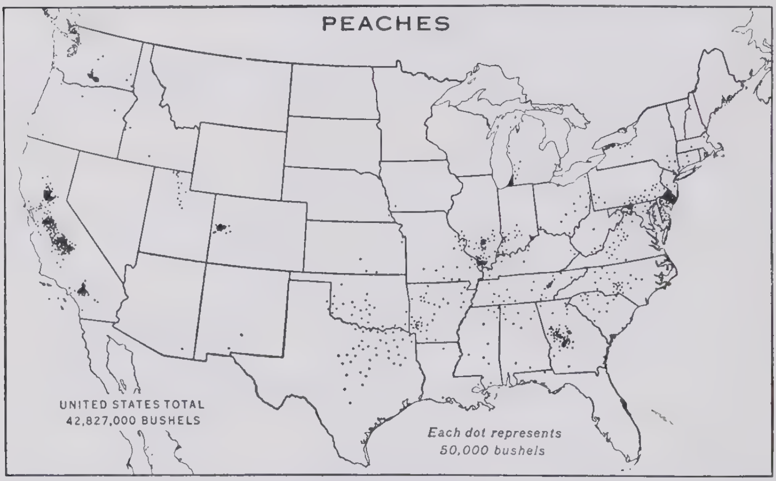


FIG. 76.—About three-fourths of the peach trees are south of the Ohio and Missouri Rivers and in California. Low winter and spring temperatures occur so frequently north of a line from Chicago to Cheyenne that the production of peaches becomes unprofitable.

chards are found in the southern states and along the Atlantic and Pacific coasts where the climate is modified by large bodies of water and along those shores of the Great Lakes where the prevailing winds tend to modify the climate enough. The peach is also grown commercially along the Allegheny ridges, where the air drainage is sufficient to prevent serious damage to the blossoms from late spring frosts.

The cherry is grown successfully in all parts of the country, from Newfoundland to Florida and from ocean to ocean (Fig. 77). Plums are widely distributed and one or more types are grown in all regions.

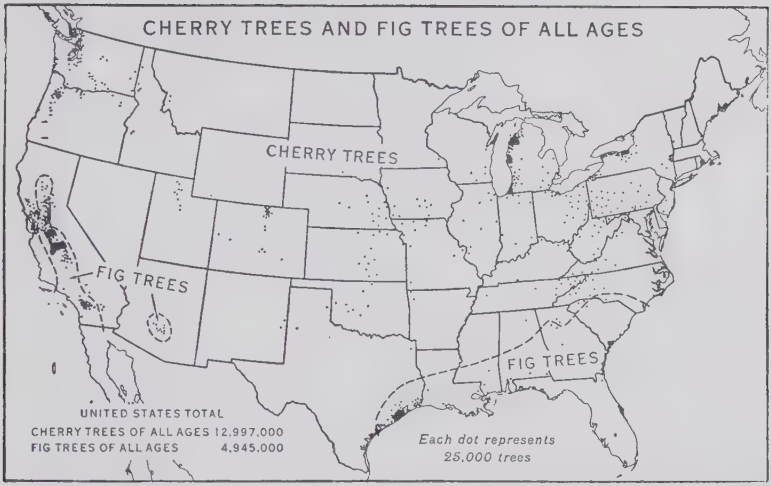


Fig. 77.—Approximate number of cherry trees and fig trees of all ages in the United States. California, Oregon, Michigan, New York, Pennsylvania, Ohio, and Wisconsin are the leading states in the production of cherries. The centers of commercial production are located in the Lake States and the valleys of the West. Very few cherry trees are found in the Southern States. Fig trees are confined chiefly to California, Arizona, and the Gulf and South Atlantic States. (U. S. D. A.)

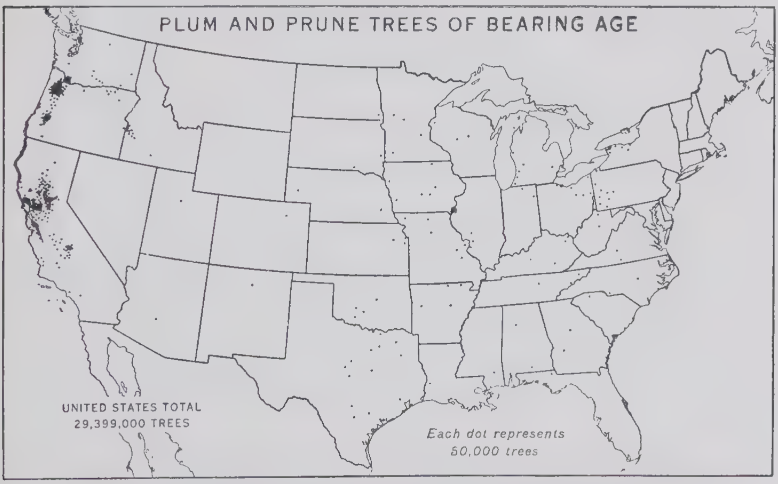


Fig. 78.—About one-third of the acreage of plums and prunes is in California. (U. S. D. A.)

Cost of a Peach Orchard.—The following table shows a summary of the cost and the returns from peach orchards in 14 peach regions:

Developing and Maintaining Peach Orchards

(N. J. Station Bulletin 452)

Section	3-Years' Cost with Int. per Acre	During Bearing Life				
		Annual Cost with Int.	No. Bearing Years	No. Crop Failures	Ave. Yield Bu.	Cost F. O. B. Bu.
N. J., Southern	$134	$189	13	1	170	$1.11
Ga., Ft. Valley	83	119	10		100	1.10
Ga., Northern	90	165	15	3	150	1.01
N. C., Sandhill	98	210	12	2	175	1.07
S. C., Sandhill	110	176	15	3	155	
S. C., McBee	68	139	12	2	140	0.91
Va., Charlottsville	70	146	15	3	150	0.98
Md., East Shore	59	147	13	2	170	0.86
Md., Western	90	152	11	3	190	1.01
Pa., Chambersburg	72	145	12	3	150	0.97
Tenn., Kingston	79	133	15	2	150	0.89
Ill., Carbondale	68	143	15	6	160	0.90
Ill., Centralia		171	15	7	160	1.06
N. Y., Western	110	141	15	3	125	1.13
Average	87	155	13	3	150	2.00

Capital Investment.—The cost per acre of establishing and maintaining an orchard for the first three years may be summarized about as follows for the regions given in the preceding table.

Year	Range	Average
First —Trees, fertilizers, labor, etc.	$22 to 49	$32
Second—Fertilizers, labor in pruning and cultivating, etc.	15 to 35	22
Third —Fertilizers, spray materials, labor, etc.	19 to 51	31

An intercrop may be grown the first three years. This should cover the cost of those years if soil and field are suitable; in some cases a profit may be shown. The fourth or fifth years some fruit may be borne in a peach or plum orchard. Orchards sometimes yield the fifth year as much as $200 or $300 worth of fruit per acre.

The Cost Factors.—The items which make up costs per acre for the first three years in the regions mentioned in the foregoing tables vary as follows:

Trees 90 to 134, costing 8 to 25 cents, averaging 14 cents.
Man hours for three years 50 to 143, averaging nearly 89.
Horse hours for three years 11 to 76, averaging 47.

Tractor hours for three years 3.3 to 11.7, averaging 5.
Cost of labor $27 to $42, averaging $29.
Fertilizers pounds 108 to 1302, averaging 580.
Cost of fertilizer $5 to $31, averaging $13.
Cost of spray materials averaged $1.31.
Interest on investments averaged $17.
Other cost items averaged $8 to $9.

Markets and Prices.—The outlet for a small orchard may be found in local markets or markets which may be reached by trucks. If fruit is to be shipped, facilities for shipping should be studied closely and road conditions should be favorable for hauling fruit to a good loading place or to market.

Prices are influenced by the season of ripening of different varieties and by the production over the country as a whole. The prices of these stone fruits are usually favorable in the large markets except when there are temporary periods of overstocking.

Location and Exposure.—In selecting the location for the peach orchard we must give the utmost attention to the question of air drainage. The peach tends to blossom so early in the spring that late spring frosts kill the pistils and ruin a year's crop. The peaches planted near the top of the hill will be far less subject to spring frost than those in the valley. A very gentle slope may be sufficient. Avoid extreme exposure to windstorms.

It is more important to have the peach crop grown on the northeast slope than with any other orchard trees. The first few warm days on a southern slope may warm the soil enough to force the trees into blossom. As the blossoms have no protection from the leaves, as in the case of the apple, they are easily killed. But sufficient air drainage will help balance this danger. If a northern or northeastern exposure is likely to prove too severe on the trees because of prevailing winds of that section it should not be chosen.

Peach Soils.—The peach will thrive well on rather light soils. Soils very heavy in clay are not well adapted to peach growing. The peach prefers soils that are warmed quickly and have good underdrainage. If the drainage is poor the leaves turn yellow and growth is slow.

High elevations usually have sufficient drainage unless there be seepage water from the hillside. Apples, pears, and plums would better be used where there is danger of the soil being too heavy for peaches.

Cherry Soils.—The sour cherry is grown in nearly all types of soil and in varied climates. It is considered much hardier than the others and less subject to enemies. The sweet cherry prefers rather rich black loam, and should be given close attention by the grower.

Plum Soils.—The American types of plum prefer light sandy loams. Other types prefer heavier soils. (Fig. 78).

Danger from Enemies.—Peach borers attack all of the stone fruits and will kill the trees if control measures are not used. Recent methods have been devised which greatly reduce the cost of fighting borers in stone-fruit trees.

San José scale and other enemies must be fought each year. Trees will not long survive if spraying is neglected. The young grower must expect to practise vigilance in fighting insects and diseases in orchards, both young and old.

Job 2. Propagating the Trees

Conditions Usually Found.—(1) Peaches are perhaps more commonly propagated by orchardists than are apple trees. (2) Most orchardists buy trees from nurseries.

Aims.—(1) Beginning orchardists should understand the methods of propagating each of these kinds of fruit tree. (2) They should know the difference between June budding and September budding of trees. (3) They should know the best nursery practices.

Problems for Study and Discussion

1. Name orchardists of your region who seem to understand the details of budding and growing young trees.
2. How many of these orchardists propagate their own fruit trees?
3. How can peach, plum, and cherry pits be obtained in your region for the growing of stocks?
4. How would you germinate these?
5. When should the young seedlings be budded in your state?
6. Debate June budding vs. September budding.
7. Discuss suitable stocks for cherries.
8. Give directions for the care of young trees in the nursery rows before and after budding.

Activities.—(1) **A nursery of peach trees** may be made interesting by using the budding method of propagation. Carry the project to completion. Careful attention should be given to labels and records. (2) **A plum nursery** project, including the three main types of plums, may be conducted in a similar way. (3) **A cherry nursery** project should be planned and pursued by some students.

Propagation of Peaches.—Improved varieties of peaches are propagated chiefly by budding. The actual budding is done either in June or September. In the extreme southern states, June budding is quite commonly practised. The buds used for the June buddings of peaches are saved from the dormant season in cold storage or in cellars. In the extreme southern latitudes green buds may be used. They are inserted on young growing seedlings started from seed early that spring. (Fig. 79).

For September budding of peaches the buds used are from the current year's growth on good varieties. They are inserted on seedlings

started from seed in the spring of that year. In this case, they do not start growth in the same fall that the budding is done. They became calloused in place and remain dormant until the following spring. At that time, the top of the seedling is cut off above the new bud and the whole strength of the sap from the root is thrown into the development

FIG. 79.—School boys budding peach seedlings with buds from good varieties. (Illinois Normal University.)

of the new shoot from the new bud. All other shoots are pruned off with the fingers and none but that growing from the improved bud is retained.

After the budded seedling has grown one season it is ready to be transplanted to the orchard. In the case of June-budded peaches, the new buds begin growth almost immediately after they are inserted. The seedling shoots are then removed and all the growth is thrown into the

new shoot. The budded peach tree is left in the nursery row until fal or the following spring, when it is ready for transplanting to the orchard.

Propagation of Plums.—Plums are grafted or budded in much the same ways as described for propagation of apples and peaches. The stocks are of several kinds for the different types of plums. For the European (*Domestica*) and Japanese plums probably the most popular are the Myrabalan plum, grown from cuttings, and the Marianna plum, grown from seeds. Marianna plum stocks have the objection of suckering. American wild-plum seedlings are much used as stocks for the budding

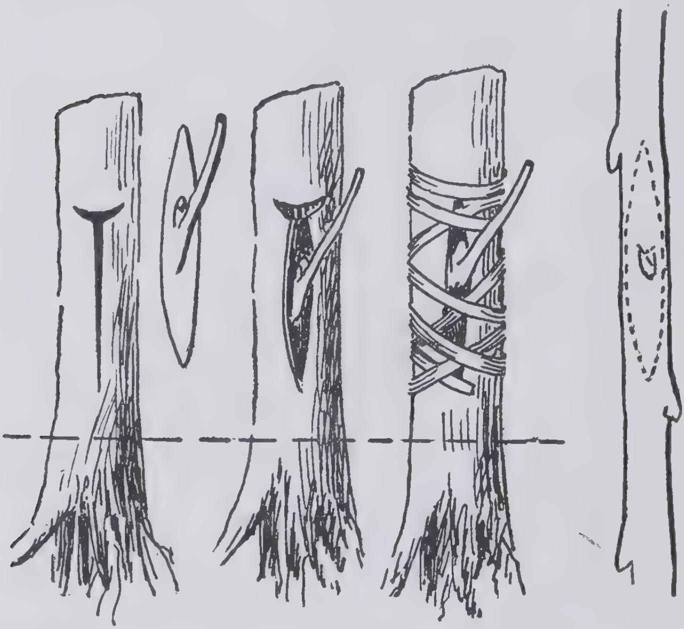


Fig. 80.—Three steps in shield-budding. At the right is a scion or budding stick from which the buds are cut as shown by the dotted line.

and grafting of improved varieties of American plums, particularly in the middle and western states. Peach stocks are well suited for use in growing plums for light soils and for southern localities.

Securing Materials for Budding.—Seeds for growing stocks are usually taken from the seedling trees. They are what nurserymen designate as "native" seeds. As the stocks do not materially influence the fruit of the orchard, it is not absolutely essential that native seeds should be used; but seeds from improved varieties are considered less

suitable for the growing of stocks as the growth may be poor and seeds may fail to germinate.

Bud sticks from which the buds are to be taken are cut at the proper season from trees of bearing age. If, for example, the limbs are taken from peach trees for August budding, they will be taken only a few days before the budding is to be done. The leaves are cut with knife or scissors, leaving the leaf stem attached beneath each bud. This protects the leaf scar and gives the operator a handle for use in placing the bud. These fresh sticks should be kept wrapped in wet paper or packed in wet sawdust until used. They may be sent long distances by express or by parcel post.

Shield-Budding.—There are many methods of budding, but the one which is rather more common than all the rest is shield-budding. It is named from the shape of the piece carrying the bud as it is cut from the plant to be propagated (Fig. 80). A T-shaped cut is made in the stock and the two corners of bark are raised and rolled back slightly. The shield bearing the bud is inserted just under the flap of bark so that the growing layer just under the bark, called the cambium layer, will rest against the wood of the stock. The bark is then placed snugly against it to hold it in place. This leaves a slight opening for the new bud, which will begin growth at the proper time. The bark and shield are held in place by wrapping with raffia.

Other Types of Budding.—Besides the shield-budding already described there are several other methods in use for special purposes.

Prong-budding is a modification of the common shield-budding which uses a short prong or spur instead of the simple bud. This is commonly used in the propagation of nut trees on the Pacific coast. The English walnut is thus budded during the dormant season. The shield-shaped bud is tied in place and also waxed. The operation is somewhat like grafting and is often named *twig-budding*.

Plate-budding differs from shield-budding in having a rectangular cut made in the bark or the stock. This piece of bark is turned down and a patch of bark of the same size and shape is cut from the scion. This bears a bud and is fitted into place on the stock. The flap of bark is brought back somewhat into place and tied. The flap of bark may be divided into two parts, in which case the bud is placed near the center and is not likely to be covered by the flaps returned to place. The olive is sometimes propagated by this method of budding.

Flute-budding differs from plate-budding in having a larger area of bark cut away entirely. The bark from the scion bearing the bud is of considerable size, cut to fill the entire area.

Chip-budding is so named because the piece from the scion bearing

the bud includes a piece of bark and wood. It is beveled in mortise shape above and below and is dovetailed into a cut in the stock made just to receive it. It should be waxed and tied in place.

Propagation of Cherries.—Budding is generally followed in the propagation of cherries of all kinds. Mazzard and Mahaleb stocks are commonly used except in Japan (Figs. 81 and 82). Russian sour cherries are sometimes used in the regions with rigorous winters. The budding is done in late summer more commonly than in June. The buds remain dormant until the following spring, when the stock is pruned off above the bud and a new top is formed by the shoot growing from the bud. Growers desiring fruit should select the trees budded on Mazzard stock,

Fig. 81.

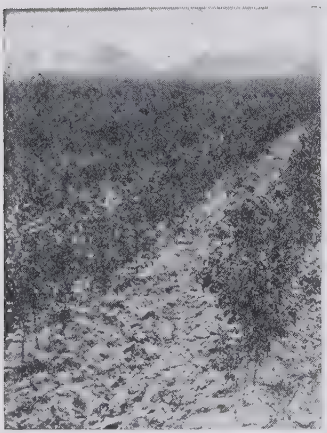


Fig. 82.

Fig. 81.—Buds of sweet cherries set in stems of Mahaleb cherry seedlings in July and August. These buds remained dormant until the next spring, when the seedlings were cut to the new bud near the ground. See the growth from these buds in figure 82. (U. S. D. A.)

Fig. 82.—One season's growth of sweet cherries budded in July and August on Mahaleb cherry stocks. See figure 81. (U. S. D. A.)

and should insist upon trees of this kind when purchasing from nurseries. The growth of the trees may not be so beautiful, but the bearing qualities will be much better than those of Mahaleb stocks.

Job 3. Choosing the Kinds and Varieties to Grow

Conditions Usually Found.—(1) Poor selections of varieties are more common for home orchards than for commercial orchards. (2) Growers sometimes confuse the two purposes for which the fruit is intended and plant home varieties for commercial purposes.

Aims.—(1) The factors governing the selection of varieties should be well understood. (2) Local soils and markets should be further studied in determining which of these types of fruit to grow.

Problems for Study and Discussion

1. If possible, find examples of farmers who admit that they have planted unsuitable varieties of these fruits.
2. How many varieties of each of these kinds would you want for a home orchard? For a commercial orchard?
3. Make a list of varieties of peaches for a home orchard. For a commercial orchard.
4. Make lists of varieties of plums and of cherries for such orchards.
5. What difficulties arise at spraying and picking times from having too many varieties?
6. Why should the time and order of ripening of your varieties be well understood?
7. Get opinions of local orchardists regarding each of the varieties on your lists.
8. Which of the varieties on your lists are grown locally?
9. Consult nursery catalogs for descriptions and prices of fruits you have selected.

Activity.—Visit a nursery or a local orchard to observe and study varieties grown. Study varieties in markets.

Varieties for Planting.—Peaches ripen at different seasons, and a succession of ripening may be secured by selecting several varieties with different ripening dates. The very early varieties are rather subject to attacks of brown rot, and as it is a very serious enemy such varieties should not be planted. Berries and other fruits may be made to take the place of such varieties of peaches. Carman is an early variety which does not rot badly.

The most popular commercial peach in the East, South, and Middle West is Elberta. J. H. Hale is also quite popular in the same regions. In the South, Hiley and Belle are two popular white varieties to precede Elberta. Carman was formerly the first important commercial peach to ripen in the South and East, but has recently become unpopular. Clingstone or semi-clingstone varieties of peaches are less popular than formerly. Eastern markets demand freestones. Augbert, a yellow freestone ripening after Elberta, is being planted somewhat in the South, and Wilma is preferred as a late yellow peach to follow Elberta farther north. The hardy varieties of peaches such as South Haven are recommended in Michigan. Greensboro is a hardy semi-cling variety grown for home use in local markets in the northern districts. Such varieties as Early Elberta, Iron Mountain, Heath, and Salwey are grown commercially in limited areas. Mayflower is probably the best very early peach for the home orchard. A different type of peach is grown for canning purposes in California. The flesh of melting varieties does not retain its form sufficiently when processed. Varieties such as Philips Cling, Palora, and Peake are yellow peaches of the firm-flesh type grown in California.

Do not grow too many varieties; four or five may be plenty. Ask

your state experiment station to recommend varieties of peaches, plums, and cherries for your section.

Cherries.—Two main types of cherry are recognized, the sweet and the sour. These come from two distinct species, but they have been greatly improved by close selection and otherwise. Those in cultivation have chiefly originated in the Old World, and our native cherries are little used.

Varieties of Sweet Cherries.—The popular varieties of sweet cherries are the so-called Hearts, the Dukes, and the Bigarreaus. Black

Fig. 83.—A block of Montmorency cherry trees during its first season's growth in the nursery. The sour varieties habitually branch the first season, as shown here.

Tartarian and Governor Wood are varieties of the Hearts. These are heart-shaped and light colored. The Dukes are represented by May Duke and Reine Hortense. These are smaller than the other sweet cherries. The flesh is very soft, and they are difficult to handle in shipping. The Bigarreaus are also heart-shaped, but have firm flesh. The Yellow Spanish and Napoleon are light colored, and the Schmidt and Bing are dark.

Varieties of Sour Cherries.—The early Richmond and Montmorency are rather small, light colored, sour cherries with rather clear

juice. The trees are somewhat upright in growth and branch while very young (Fig. 83). The Montmorency is recommended by the Michigan Station as the most profitable variety.

English Morello and Louis Philippe are small sour cherries, dark in color with dark clear juice. The trees are characterized by a drooping habit.

Types and Varieties of Plums.—Three main types of plums grown in cultivation are: (1) the Japanese group, including Burbank, Abundance, Satsuma, and many others. This group is abundantly grown in California as well as in all other sections of the country.

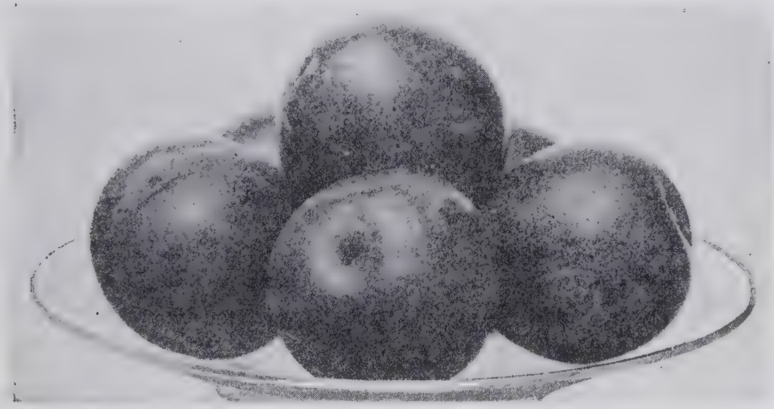


FIG. 84.—Miner variety of American plum. A good red fruit, and the variety is used as stocks for American plums. (Iowa Station.)

2. The *domestica*, or European plums, represented by Lombard, Bradshaw, Yellow Egg, Green gage, Reine Claude, Quackenboss, and many others. Prunes and Damsons belong in this group. This group of plums is more popular in the northern and eastern plum-growing sections than in any others.

3. Plums of the American type, natives of America. These include the common wild plums and the improved varietal forms of several species. In this group are usually grown such varieties as Wild Goose, Wayland, Miner (Fig. 84), Golden Beauty (Fig. 85), Newman, Moreman, Lone Star, Caddo Chief, Milton (Fig. 86), and many others.

Job 4. Locating the Site

Conditions Usually Found.—(1) Commercial orchards are usually well located as to air drainage and exposure; home orchards are often less favorably situated. (2) Favorable locations and suitable soils are sometimes not found for the particular type of fruit desired.

Aims.—The factors governing a good site and location should be well understood by young orchardists.

Problems for Study and Discussion

1. Find local orchards which are favorably located; contrast these with others badly located.
2. Why is air drainage more important for the stone fruits than for apples?
3. Show the relation of air drainage to fruit injury.
4. Review the types of soil desired for each of these fruits.
5. Discuss factors which govern orchard location in a level region: distance from house, from public road, from good private road.

FIG. 85.—Golden Beauty plum.

FIG. 86.—Milton plum.

6. What types of subsoil would you want for peaches; for plums; for cherries?
7. Discuss the importance of handiness to market for peaches, plums, and cherries.
8. Choose a good site for a proposed orchard and enumerate its advantages and disadvantages.

Air Drainage.—All of the stone fruits blossom early in the spring. Late spring frosts are liable to occur during the blossoming period, and fruit crops are thus often killed. When orchards are on suitable slopes where the air drainage is good, frosts are less likely to injure them during the blossoming period. Cold air settles down the slopes, and a few degrees of difference on a frosty night may save the crop. Drainage also starts air currents which may prevent frost formation.

Elevation of the orchard site above sea level is important to prevent killing of peach buds, both in winter and in summer. On the coast from New York south to Virginia peaches should be planted at elevations of 100 feet or more. In some of the hilly sections in the northern and east-

ern peach districts peaches should usually be planted at elevations of not less than 300 to 600 feet.

Influence of Large Bodies of Water.—Orchardists in some regions are able to benefit by the proximity of large bodies of water which tend to prevent injury from frost. Atmospheric temperatures are more nearly uniform during all seasons.

Aspect.—In nearly all climates the peach tends to open its buds with a few warm days even in January, February, or March, before winter is really over. In northern and eastern exposures the soil remains cold and the sap is not forced into circulation through the tree enough to cause the buds to open. The fruit is therefore not so likely to be killed if the blossoms do not show before spring weather has come to stay. The exposure problem is more important for the stone fruits than for most other kinds of fruit.

Soil and Soil Drainage.—The orchardist must consider the soil, subsoil and the water drainage carefully in locating the orchard. Types of soil have been suggested in Job 1. Subsoils should not be too open for plums and cherries. The Japanese type of plums may be grown on heavier soils and subsoils than the others. Sour cherries are often grown on heavier soils than sweet cherries, peaches and American plums. Very light soils are sometimes used for peaches and American plums, provided the subsoils are not too gravelly.

Job 5. Buying Trees and Receiving Shipment

Conditions Usually Found.—(1) For small orchards, trees are sometimes foolishly purchased from unreliable agents instead of from good nurseries. (2) Growers of large orchards are usually very careful to buy good trees.

Aims.—The best methods of securing good trees and their early care should be understood by students.

Problems for Study and Discussion

1. Talk with growers regarding their methods of securing good trees.
2. How do they care for them upon arrival?
3. How long in advance would you put in an order for trees? Why?
4. If you visited a nursery and found trees poorly cared for, poor facilities for treating against insects, and trees unthrifty, what would be your conclusion?
5. Debate buying June-budded vs. September-budded trees.
6. In making a tree order, how do you designate the size of tree desired?
7. What agreement regarding trueness to variety will a good nursery make?
8. What shipping directions should be given to the nursery?
9. What should be done with the trees when the shipment arrives?
10. Why not leave trees in shipping box until time to plant?
11. Why would you not have a nursery prune the tops of the trees before shipment?
12. Describe how, where, and why to heel-in trees.

Activities.—Find specimens of crown gall or club root on young trees and learn to identify these troubles.

June Buds vs. August Buds.—Some commercial orchardists plant June-budded peaches. This is more common in central and south-

ern latitudes than in the northern region. Otherwise peaches and plums are almost invariably yearlings when planted in orchards. June-budded trees are much smaller and cheaper than August-budded trees grown in a nursery for a year longer. Where the season of growth is long some orchardists are willing to risk planting the smaller trees, but better results are obtained if strong nursery trees are selected.

Inspecting Nursery Trees.—When state inspectors visit nurseries they are not always able to detect diseases on the roots. For this reason

FIG. 87.—Inspecting peach trees just received from the nursery. At left are September-budded trees, at right two sizes of June-budded trees. (N. J. Station.)

trees should be closely inspected by growers as soon as they are received from the nursery (Fig. 87). Watch for swellings or deformed growth, which may indicate the presence of club-root or crown-gall troubles. If symptoms are found, show the roots to competent persons and report to the nursery and to the state experiment station.

Care of Trees.—Open the shipment and heel-in the trees as they are inspected. Avoid exposing roots to the sun and wind (Fig. 88).

Job 6. Preparing the Soil

Conditions Usually Found.—(1) Commercial orchardists seldom make serious mistakes in preparing orchard soils. (2) A few are apparently in a hurry to start the orchard without proper preparation.

Aims.—Methods of thorough preparation of soil before planting should be understood and practised.

Problems for Study and Discussion

1. Outline a plan by which a green-manure crop can be grown and plowed under for improving your orchard site.
2. Discuss fall and spring plowing in preparing soil for an orchard.
3. Under what conditions would you plow the whole area deep? When shallow?
4. What is a deep-tillage machine?
5. Describe proper condition of subsoil and surface soil for planting an orchard.
6. Give the steps in preparation to follow the first plowing.
7. What terracing would be advisable on a steep slope?

Fig. 88.—Peach, plum, and cherry trees should be heeled-in as soon as received from the nursery. Firm the soil well about the roots. (Indiana Station.)

8. Compare wide terraces with a plan of having one terrace for each row of trees on a hillside.
9. How does terracing aid in allowing orchard cultivation during the life of the trees?

Activities.—Assist in laying out terrace lines for an orchard site. Grade the terraces.

Improving Poor Soils.—When light soils are to be used for fruits requiring more fertility, green manure should be plowed under and allowed to rot well in advance. Green manure is usually cheaper than barnyard manure, and if well rotted will furnish suitable fertility.

A sod crop may be plowed under in the fall, using shallow furrows. This may be replowed much deeper in the spring. This method of preparation is rather expensive, but should pay by stimulating better growth

of trees. Some orchardists use a deep-tillage machine, which is really a double disk plow with one disk set deeper than the other. The soil and subsoil are thoroughly pulverized and mixed together by this machine.

When the soil and subsoil are both rather light or open in texture, orchardists prefer not to plow the soil deep over the whole area; shallow plowing is practised. Where the rows of trees are to be planted a few deep furrows are turned under to furnish a good bed in which to start the growth of tree roots.

Preparing the Surface.—In the spring after plowing, even if fall plowing has been done, the soil should be disked and harrowed to put the

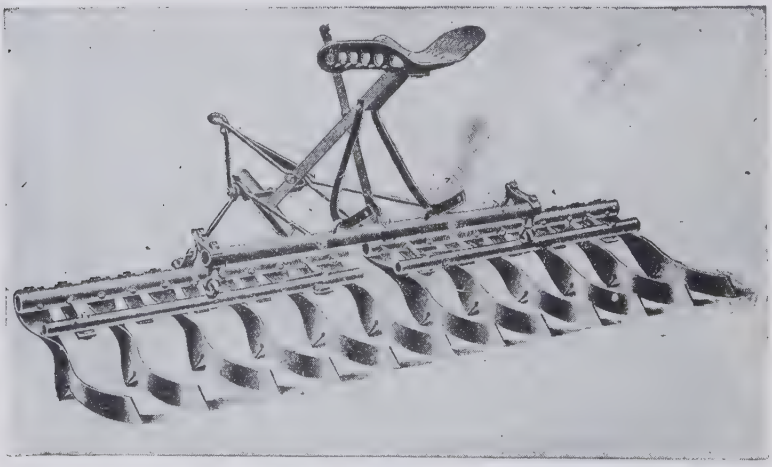


FIG. 89.—Acme pulverizing harrow, used as a general-purpose harrow. It is used for smoothing newly plowed ground or for the final preparation of a garden seed bed. It is a good orchard harrow.

surface in good condition for marking off the rows, digging the holes, and planting the trees (Fig. 89).

Terracing Hillsides.—On steep hills it may be advisable to form a terrace for each row of trees. To do this, the soil may be prepared in the usual way and the trees planted with no more terrace than a furrow or two thrown downhill. The future tillage between rows will gradually form the terraces desired.

To establish the first terrace line, a line of stakes is located by use of a leveling instrument around the hillside. This line of stakes may be level or have a very gradual fall in one direction.

Wide terraces are sometimes preferred if the slope of the hill is very

gradual. One row may be located on each terrace and two or more rows may be planted on the slope between the terraces.

Job 7. Laying Out the Site, Digging Holes, and Planting

Conditions Usually Found.—(1) Stone fruits are usually planted according to the rectangular or square method of planting. (2) When hillsides are terraced, the rows commonly follow the terraces. (3) Good methods are used by commercial growers for digging holes and planting trees.

Aims.—Rapid and efficient methods of laying out the rows, digging holes, and planting trees should be understood by students.

Problems for Study and Discussion

1. Find orchards in your region which were planted on the square system. Find reasons which governed their planting.
2. What distances are found between trees in your region for peaches, plums, and cherries? Compare these with distances recommended.
3. Ask orchardists to discuss the layout and distances with reference to the spraying job.
4. Describe a good method of marking off the rows for digging holes.
5. What is the easiest way of getting the trees in rows in two directions?
6. Describe how to dig holes for these trees.
7. How would you prune the roots of trees before planting?
8. Compare pruning the roots and tops before planting and after planting for low-headed and high-headed plans.
9. How would you organize a crew of workers for setting an orchard
10. How can tree roots be protected during the planting job?

Activities.—(1) Practise laying lines at right angles to each other. (2) Assist in laying out orchard rows and staking places for trees. (3) Each student should make a planting board. (4) Practise digging holes and planting trees.

Laying Off the Orchard.—This job is described in the apple enterprise. If two sides of the field meet at right angles, two lines should be run and the intervals measured carefully on these two lines, after which the stakes for all other trees are easily located.

Intervals.—Peaches are usually planted about twenty feet apart each way in soils where the growth will be large. If low-headed trees are to be maintained and close pruning is to be practised, the distances may be reduced to eighteen feet one way for some varieties. Close planting was once the common practice for commercial orchards, but the use of tractors and sprayers is causing orchardists to leave more space between rows. Trees of these fruits are sometimes set with the rows twenty-four feet apart. The Michigan Station reports results favoring distances of a rod each way for cherries.

Digging Holes.—If two, three, or four furrows are thrown outward for each row of trees, the handwork for digging holes will be greatly reduced (Fig. 90). This plan also loosens plenty of top soil for use of the workmen planting the trees. When soils are light the labor of digging holes should be very slight if the plowing method is used.

Pruning before Planting.—Young trees may be injured in digging

at the nursery or in shipment. The roots should be pruned enough to remove broken ends and extra long growths.

If each tree is to be handled in this way, the workmen can cut each top in less time than would be required for pruning the trees after planting. If trees are to be headed at a height of about two feet, the top may be cut at that height before planting.

The Planting Crew.—If trees are hauled from the heeling-in place to the orchard rows on a sled or low wagon in a barrel or tub of water, the roots will not be injured by sun and wind. Two or three workmen should form a crew for planting. Another crew may be preparing the holes in advance. When three men are planting, one should lay a tree in each hole and two should plant the tree, one holding the tree in posi-

FIG. 90.—Laying off rows for planting peach trees. If the furrows are very straight this method of laying out the orchard will save considerable labor in setting the trees.

tion while the other throws good soil on the roots. The man holding the tree does the tramping of the soil as it is thrown into the hole. The head man who is distributing the trees among the holes may be able to attend to the hauling of trees from a central heeling-in place.

Job 8. Growing Intercrops and Cultivating the Orchard

Conditions Usually Found.—(1) Unsuitable crops are sometimes grown in young orchards. (2) Neglect of orchards is too common. (3) Commercial growers usually follow good methods of intercropping and cultivating.

Aims.—The best methods of intercropping and cultivating should be well understood and practised by beginners.

Problems for Study and Discussion

1. What intercrops are grown in young orchards of your region?
2. Make a list of the intercrops which you think could be grown to best advantage.

3. How does marketing enter into this problem?
4. What are the advantages of growing intercrops for a few years in the young orchard?
5. What relation has the use of a winter cover crop to the choice of an intercrop grown in summer?
6. What is the danger of cultivating or digging an intercrop too late in the year?
7. Under what conditions would you defend the use of a sod in a bearing peach orchard?
8. What are the advantages of clean cultivation of orchards?
9. Outline a plan for the annual tillage management of an orchard.
10. Review the topics in Jobs 8 and 9 of the apple enterprise.

The Year's Cultivation of Orchards.—Plow the heavier soils by turning with a turning plow in early spring. Let this approach as close to

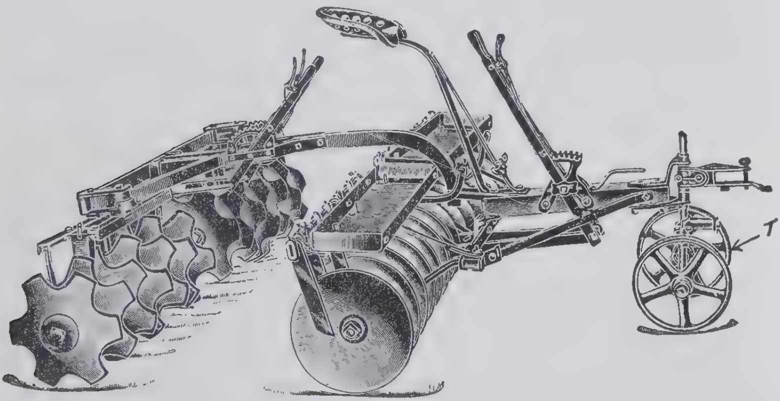


FIG. 91.—The cutaway-disk harrow is well adapted to pulverizing the surface soil and preparing a seed bed for gardens. Smooth-edged disks give similar results. They may be used together as here shown with truck or forecarriage or they may be arranged for use separately. In clean-culture orchard work the disk harrow may be used for most of the summer tillage after the spring plowing. Soil may also be disked for the sowing of a cover crop in late summer or early fall. (Weir's Productive Soils.)

the trees as possible. If the slope of soil will allow it, tillage implements may be run both ways. The small square near each tree can be worked up with such hand tools as grubbing hoes or mattocks. Loose soils are seldom plowed, but are heavily disked by using tractors or heavy teams. The disk harrow or cutaway harrow (Fig. 91) should be used to crumble the soil. Some such implement should be used several times. It will prevent the baking of soil and will keep down the growth of weeds. Other tillage implements, such as the acme spike-tooth and spring-tooth harrows, may be used at short intervals after the first plowing and disking.

By midsummer it is usually best to stop tillage. This will allow the trees to stop growing and ripen their wood and form the bud scales for

winter protection. They are then less likely to be injured by winter freezing.

Fig. 92.—Garden truck planted between the rows of newly set trees in a young orchard. (New Jersey Station.)

Fig. 93.—Boston Marrow squash growing between the rows of a two-year-old peach orchard in Massachusetts. Intercropping is used only in young orchards. (F. C. Sears.)

A part of the annual tillage should include the sowing of the winter cover crop at the time when the cultivation ceases in July. The seed may

be sown just before or just after the last cultivation. A good cover-crop mixture for August sowing is one bushel of rye, one peck of winter vetch, and one-half peck of crimson clover per acre. If sown in July omit the rye; and some rye seed may be broadcasted in the others in September. Seeds can be sown with a hand machine or merely by hand. It is usually best to cover the seed with a harrow. In northern latitudes the crimson clover may be omitted from this mixture and the quantity of the other seeds slightly increased.

The spring plowing or disking may be delayed until the winter cover crop has made a slight spring growth, but avoid drying out the soil too

Fig. 94.—Orchard peach trees two years old. The one at the right has been fed liberally with much nitrogen in the fertilizer. The other has received no fertilizer.

much by this means. A good growth of green manure worked into the soil should supply an abundance of nitrogen, so that no other nitrate fertilizer need be used.

Intercropping.—The principles regarding intercropping mentioned for the apple orchard apply here (Figs. 92 and 93). If crops which require thorough cultivation are grown between the trees, then the trees will receive the cultivation they need. Do not grow such tall crops, as corn or sorghum between the trees. They tend to shade the trees too much unless wide spaces are left between the crops and the trees. Early varieties of Irish potatoes are suitable, if the soil is favorable and the season is long.

It is well to let the orchard have very little if any cultivation during the latter part of the summer and early fall. Plan to remove the intercrop in time to start a cover crop early in August or before.

Job 9. Providing Plant Food

Conditions Usually Found.—(1) Many growers provide most of the organic matter and some plant food for the orchard by turning under a green-manure crop each year. (2) Many use commercial fertilizers, either with or without organic manures.

Aims.—The most economical and efficient methods of providing plant food for trees and fruit should be understood and practised by young orchardists.

Fig. 95.—A winter cover crop may be turned under as green manure each spring. This may supply nitrogen and organic matter for the growth of young trees.

Problems for Study and Discussion

1. What plant foods are supplied to the orchard when barnyard manure is liberally applied?
2. Which ones are supplied by turning under a green-manure crop each year?
3. Describe a system of management whereby you could grow and turn under a green-manure crop each spring.
4. Talk with local growers regarding the forms of commercial fertilizer used for nitrogen, phosphoric acid, and potash.
5. Give reasons for studying the growth of trees before applying commercial fertilizers.
6. Why would you rather modify your own fertilizer mixture than buy ready-mixed materials?

7. Find the best practises regarding the time for applying commercial fertilizers.
8. Review the topics on fertilizing in Job 10, apple enterprise.

Plant Food Requirements.—Young trees need to be supplied with plenty of nitrogen in available form (Fig. 94). If the leaves are not of a healthy dark green color more nitrogen is needed. Keep growth of young trees stimulated by use of fertilizers when needed. A winter cover crop may be plowed under as green manure each year (Fig. 95).

In that case the only commercial fertilizer which needs to be added will contain phosphoric acid and potash. If the trees are making a good growth and are not bearing much, both of these plant foods are needed. On medium soils use about 150 or 200 pounds per acre of a mixture containing 6 to 8 per cent of each of these plant foods. The smaller quantities may be applied to young orchards and larger quantities to bearing orchards.

Job 10. Pruning Trees and Thinning Fruit

Conditions Usually Found.—(1) The best commercial orchardists practise good methods of pruning trees. (2) Many of them thin fruit with profit when conditions require it. (3) Neglected trees are commonly found in home orchards.

Aims.—(1) Systems of pruning by proper methods should be understood and practised by students. (2) They should know the advantages and methods of thinning peaches and plums at the proper time.

Problems for Study and Discussion

1. Compare local orchards which are properly pruned with others which are seldom or never pruned.
2. Get opinions of growers regarding the value of pruning orchards.
3. If you find any who do not believe in pruning, try to discover whether they really understand how to perform this job.
4. Contrast high heading and low heading of trees for the peach orchard; for the plum orchard; for the cherry orchard.
5. Give directions for the annual pruning of a bearing peach or plum tree.
6. Why should side branches be pruned close to the main limb?
7. Give instructions for proper cutting of limbs.
8. Describe suitable pruning tools for a peach orchard.
9. Contrast the pruning of peaches with the pruning of cherries.
10. Show the relation between close pruning and thinning of fruit.
11. What are the advantages of thinning peaches and plums? When should this be done?
12. Why do so many growers fail to thin their fruit?
13. Review the topics in Job 11, apple enterprise.

Activities.—Students should practise pruning young orchards and bearing orchards of the different stone fruits. This may be in their own or in neighboring orchards.

Pruning Tools.—The best tools for a peach, plum, or cherry orchard which has not been neglected are those shown in figures 96 and 97. The large shears or a small saw may be used in removing injured limbs or others which need removing. The hand shears should be used in cutting small shoots and twigs within reach of the ground. A long handled pruner is

needed for the tops of the trees. Steel-handled loppers are superior tools for top pruning. Always cut back new growth at a forking place in the top, so that sap will continue to flow along its channels.

Stone-Fruit Trees Compared.—Cherries need much less annual pruning than do plums and peaches (Fig. 98). Most varieties of cherries need little cutting back of new growth, but a reasonable amount of thinning is often necessary.

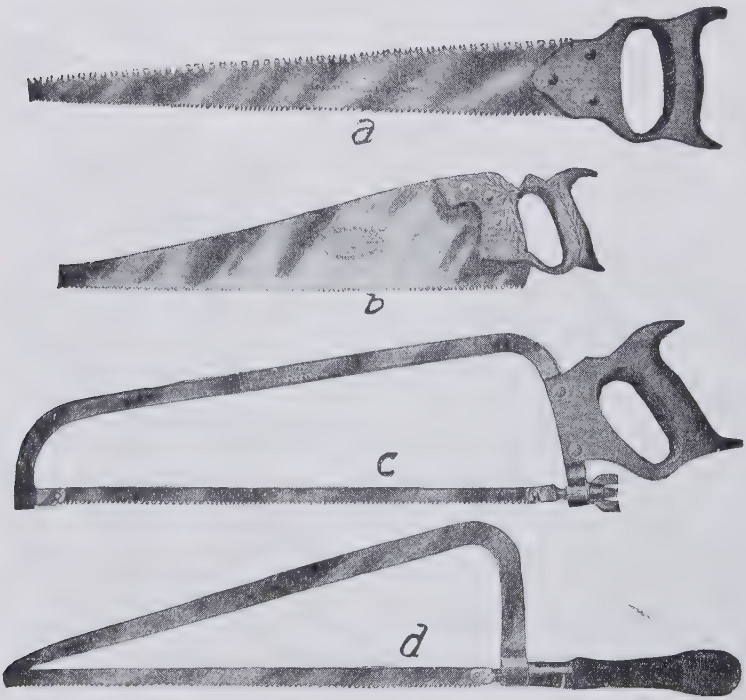


Fig. 96.—Four types of pruning saw: *c*, *d*, swivel bladed saws for use in close places; *b*, 5-point solid blade for very large limbs; *a*, double-edge saw often sold, but liable to do much damage. (Nebraska Station.)

Pruning Work of the Year.—The chief pruning of either the apple or peach orchard should come in the winter season. Directions for pruning have been given in the apple enterprise. The chief points to be borne in mind are that trees will need to have the branches thinned to let in more light, dead branches must be cut away, all injured parts must be removed and long branches should be cut back somewhat. The trees should be kept well balanced and somewhat symmetrical (Fig. 100). At any time during

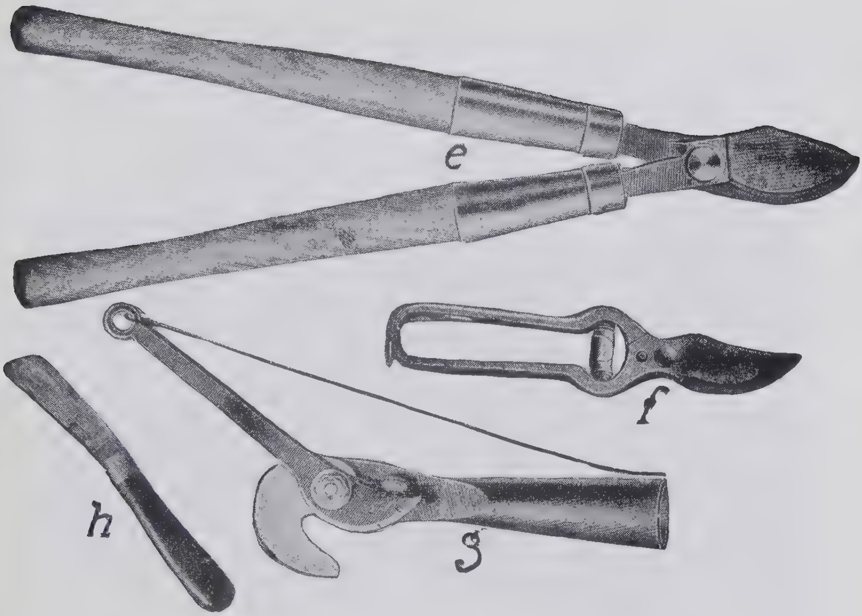


FIG. 97.—Large shears, *e*, will hasten the pruning work; hand shears, *f*, are necessary for small trees and twigs. The hole pruner, *g*, aids in the high tops. The heavy pruning knife with hooked blade is used on small limbs and for smoothing the saw work. (Nebraska Station.)

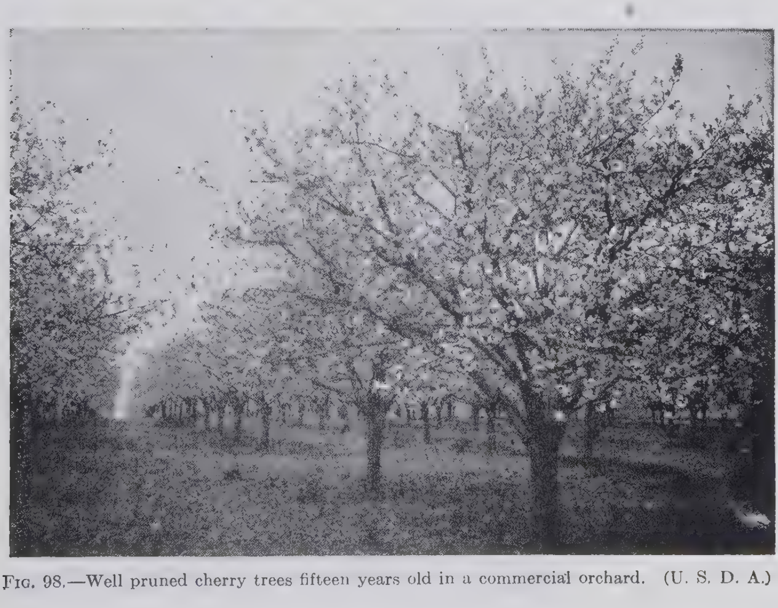


FIG. 98.—Well pruned cherry trees fifteen years old in a commercial orchard. (U. S. D. A.)

FIG. 99.—Peach tree three years old, before pruning, Pickens, South Carolina. (U. S. D. A.)

FIG. 100.—Same tree as that in Fig. 99, after pruning. (U. S. D. A.)

the year when injury occurs by the wind or any accident, pruning should be done immediately. Cover wounded places or marks where large branches have been removed by painting them.

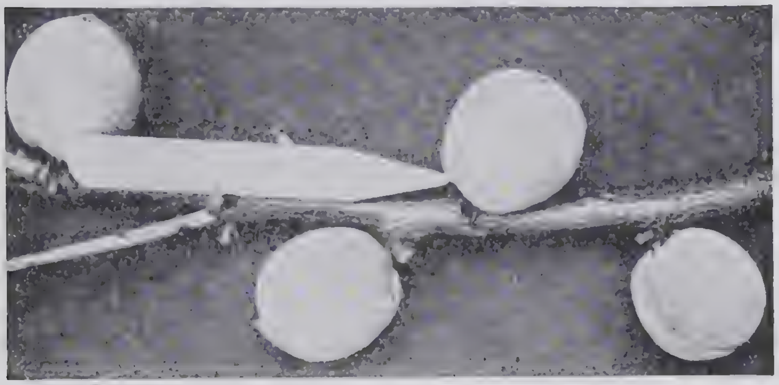


FIG. 101.—Thin peaches, apples and other large fruits to give them room and strength for growth. The fruits are enough larger to pay for the work. (New Jersey Station.)

FIG. 102.—Heavily laden trees are liable to break down, resulting in injured trees and loss of fruit. Crowded fruit is also liable to rot.

It is well to practise some pruning in the summer season. Pinch off the little shoots that are out of place, particularly on the large branches and on the trunks of young trees. These can be removed with

the fingers at that time without injury, and the growth during the remainder of the summer will be directed to better channels.

Thinning.—The benefits of thinning fruit are numerous. The quality is better and price may increase accordingly (Fig. 101). Work is saved at harvest time by having less to handle. The trees will be more likely to bear every year instead of in alternate years. Fruits which crowd each other on the trees are liable to rot, and rot spreads rapidly with great resultant loss (Fig. 102).

Job 11. Controlling Diseases

Conditions Usually Found.—(1) Brown rot and other diseases in stone-fruit orchards are very destructive, and many growers fail to control them. (2) Some varieties in home orchards are entirely worthless in many seasons because of diseases.

Aims.—The several diseases of peaches, plums, and cherries and the methods of preventing them should be understood by students.

Problems for Study and Discussion

1. Find how many local growers have had serious losses from brown rot and other diseases.
2. Describe the attacks of brown-rot disease on peaches, plums, and cherries.
3. What varieties in your region seem most susceptible to this disease?
4. Describe the effects of peach scab, leaf curl, and shot-hole fungus.
5. Describe methods of controlling these three troubles.
6. What are the symptoms of peach yellows?
7. To what extent has this disease been found in your region?
8. Ask local growers about rosette and little-peach diseases and their effects on trees.

Activities.—Make collections of diseases which affect any of these trees or their fruits. Plan to preserve these specimens in the most suitable ways.

Brown Rot of Peaches.—This is probably the worst fungous disease of the peach and plum (Fig. 103). It is most serious upon the early ripening varieties, but is found to some extent on nearly all varieties unless sprayed. Select varieties least affected by the brown rot and always spray.

Spraying for Brown Rot and Curculio.—The combined spray materials may be used in controlling curculio and brown rot. The beetles come from their winter hiding places to feed on opening buds. In the campaign use "dry-mix" lime-sulfur with one pound powdered arsenate of lead: (1) when the buds are bursting and show a little pink, to kill old spores and some adult curculio; (2) just after petals fall; (3) a week or ten days later. If needed, spray for rot four weeks before ripening and for second-brood curculio in the South about two months after petals fall.

Peach Leaf Curl.—This is a fungous disease which affects the foliage of peaches and often causes severe dropping of leaves in early summer or later (Fig. 104). The trouble is usually controlled without special effort while spraying orchards with fungicides for other diseases such as brown

rot and scab. Where the disease is serious, use concentrated lime-sulfur in winter for leaf curl and scale.

FIG. 103.—Brown rot (monilia) on peach and plum. It affects the fruit, twigs, and leaves of all stone fruits.

Peach Scab is a serious disease of the peach in some sections. It affects the fruit and causes black spots on the skin of the fruit, which in serious cases coalesce until large areas are blackened. The twigs resemble apple twigs attacked by twig blight.

The campaign described for the control of brown-rot disease will be effective in the control of scab. The disease is serious except in the most northern districts.

FIG. 104.—Peach leaf curl disease which attacks branches of cherry, peach, and plum.

Peach Yellows.—This disease is difficult to recognize. Its cause is not known. Symptoms which indicate the disease are: (1) red, spotted character of the fruit: the spots and red lines of flesh beneath them are scattered, and appear on one side before they do on the other; (2) premature ripening and uneven ripeness of fruit; (3) bitter and insipid taste of such fruits; (4) tip growth of small yellowish leaves from terminal buds; these leaves are stiff, narrow, and stand outward from the stem; the tip growths may appear late in the season; (5) stiff-leaved, yellowish shoots from the body of the tree; these may become dense tufts; (6) small, slender growth of all new wood (Fig. 105), with narrow, small leaves; these may be yellow or reddish in color; (7) death in a few years.

Do not confuse attacks of borers or of starvation with the yellows disease. Rosette, little peach and leaf curl are diseases which are likely to be mistaken for yellows.

The treatment, when yellows is positively found, is to take out the tree, roots and all, and burn it entirely. No spraying or other cure or prevention has yet been found.

FIG. 105.—A pretty certain indication of the yellows disease. Numerous weak twigs and branches with premature starting of leaves in early spring. (New Jersey Station.)

Shot-Hole Fungus.—The most serious shot-hole disease of the peach is the so-called bacterial leaf spot. The disease causes small irregular holes in the leaves, which later fall off. Cracks and diseased areas also occur in the fruit.

It is most serious in peach districts from southern New Jersey southward. It is also most serious upon light or dry soils that are deficient in nitrogen. Such varieties as J. H. Hale and Connetts are most seriously attacked, while Elberta is somewhat susceptible. Hiley is a resistant variety. This cannot be controlled by spraying. Where the disease is

troublesome peaches should be planted upon the better soils and the trees should be kept growing vigorously.

Root Gall.—The larger roots and crowns swell and become knotty. Trees become unthrifty and leaves yellow, and death may follow. The trouble usually starts from nursery or orchard soils. Examine trees closely as they come from the nursery and discard all which show the least sign of the attacks. Never plant trees where bush fruits, cowpeas, soybeans, or other plants have had such troubles.

Job 12. Controlling Insects

Conditions Usually Found.—(1) Borers, scale insects, and other insect enemies are found in orchards everywhere; curculio insects prevail east of the Rockies. (2) Commercial growers and some owners of small orchards control these enemies very successfully and systematically. (3) Some neglected orchards are found in many regions.

Aims.—A knowledge of the attacks and life histories of the insect enemies and the best methods of controlling insects should be understood by all.

Problems for Study and Discussion

1. Estimate after talking with growers how much of the fruit crop of your region was injured by curculio the last season.
2. Describe the attacks of curculio and give the life history of the insect.
3. How is this enemy controlled?
4. Review the work on San José scale, the apple Job 14.
5. Ask growers regarding the damage done by San José scale and other scale insects in their stone-fruit orchards.
6. How and when would you fight this enemy in your peach, plum, or cherry orchard?
7. Give the life history of peach tree borers.
8. When and how should borers be dug out from young trees?
9. Describe the treatment against borers for older trees, using paradichlorobenzine.
10. How much damage has been done by peach borers in peach, plum, and cherry trees in your region?
11. Find from growers if possible what other insects affect these trees or fruits and find remedies.

Activities.—Collect insect specimens and results of insect injury for study in class. The specimens should be preserved. Practice treating peaches for borers as described in this job.

The Plum Curculio.—This is one of the worst insect enemies of the fruit itself. All types of stone fruits are attacked. The little beetles lay eggs on the surface of the fruit when it is about the size of the garden pea. The young hatch and eat their way into the fruit at a wound made by the adult. The larva feeds on the flesh of the fruit, chiefly near the stone. This causes much fruit to fall. This should be picked up, as by pigs, otherwise larvæ soon crawl into the soil. Chickens and birds may catch some. Frequent tillage for five weeks after this will destroy many and prevent their second brood. Winter hiding places should be destroyed by plowing-under rubbish and burning borders.

As the adults lay their eggs chiefly in the morning twilight they can be destroyed by jarring the tree and catching the adults on stretchers made for the purpose. This is only a partial control.

Three sprayings besides winter spray are necessary where curculio are most serious, elsewhere omit poison from the pink bud spray. These sprayings may be made while fighting brown rot.

Fig. 106.—The peach tree borer: (1) female moth at rest; (2) male moth; (3) larva, or grub, feeding in burrow; (4) cocoon; (5) cocoon with pupa emerging; (6) empty pupal case protruding from a burrow. (Ohio Station.)

Peach Tree Borers.—Trees of all the stone fruits are attacked by these insects. Trees are weakened by the borers digging in the upper roots and crowns. The soft wood is preferred by the borers. Specimens are sometimes found several inches below the surface and sometimes a foot above the surface of the ground. The adult insect is a moth with transparent wings (Fig. 106). Eggs are laid on the bark of the trees near the ground, and the larvæ when hatched eat inward.

One remedy for young trees is to dig out worms and kill them with a knife or wire. To do this it is well to remove the soil for several inches

below the surface. In a few days the larvæ may be located by their borings.

Recent experiments have developed another remedy applicable to trees about five years old or over. Paradichloro-benzine is used to destroy the borers beneath the surface of the soil, at the rate of one ounce per tree for older trees, and about one-half ounce for a tree three or four years old. It should be used in the fall after all eggs have probably hatched and before the soil temperature falls below 60° F. Remove the litter from around each tree with a hoe, sprinkle the powder in a two-inch band on the bare soil some two inches or more from the trunk

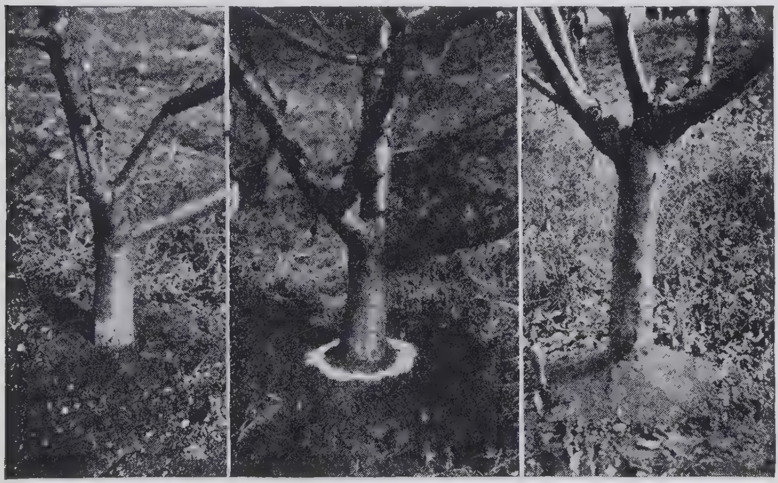


FIG. 107.—Steps in treating peach borers with paradichloro-benzine. Left, litter and grass removed from surface; centre, one ounce of the chemical placed in a narrow band two inches from tree; right, soil free from litter packed with shovel around tree, to a depth of three to six inches. (New Jersey Station.)

(Fig. 107). Cover this with a few inches of soil, tamping it with the back of the shovel. The chemical evaporates and the fumes destroy most of the borers without injuring the trees. The cost per tree is less than that of the laborious method of digging out the larvæ.

Other Insects.—The small flat-headed apple-tree borers often attack the limbs of peach trees in some regions. Thorough spraying for other enemies should be effective in controlling this enemy.

The small limb borer is often serious in its attacks upon peach limbs. Methods for its control are not well understood, but thorough spraying with lime-sulfur for San José scale should help in controlling this enemy. Cleaning the bark and digging out infested places are recommended.

Aphis is sometimes serious in plum and cherry trees. Methods recommended for apple aphis may be used against this enemy.

Japanese Beetles.—A region radiating from near Philadelphia is seriously infested with Japanese beetles which were believed to have been introduced in nursery importations in 1916. The beetles are bronze green in color and somewhat resemble rose chafers in shape and in their attacks on leaves of many plants. They are related to common grub worms. More than 200 kinds of plant are attacked. They are very serious on leaves and fruits of apple, quince, peach, cherry, plum, grape, and blackberry. Many shade trees and ornamental shrubs are attacked. Beetles emerge from the soil in the middle of June.

Spraying very thoroughly with poison mixtures is recommended: 3 pounds powdered arsenate of lead, 2 pounds flour, and 3 pounds lime in 50 gallons of water is effective if all new growth is kept protected with the spray.

Oriental Peach Moth.—Another name of this serious pest is fruit moth. It is related to the codling moth but is much more serious, as there are four to six broods a year. The larvæ feed on foliage, inside the fruit, and twigs. They are said to be more serious than curculio in stone fruits southward from New York.

Control measures have not been well determined. Spraying with poisons is probably the best measure, but this fails to reach the larvæ feeding within the twigs and fruit. Poisoning several times should kill many before they enter those places.

Job 13. Spraying

Conditions Usually Found.—(1) Commercial orchards are successfully sprayed according to good spraying programs, and excellent fruit results from such work. (2) Beginners and some careless growers make serious mistakes in failure to spray or in improper spraying.

Aims.—The purposes, materials, time, and methods of spraying should be understood and practised by all.

Problems for Study and Discussion

1. Choose the best type of sprayer and other apparatus found in your region to suit your own orchard.
2. Find the cost of such an outfit.
3. Compare catalogs of different manufacturers as to styles of equipment offered and prices for the same.
4. What materials would you mix together in fighting enemies of stone fruits?
5. Formulate a spraying campaign to suit your orchard, giving the seasons for applying each spraying.
6. Review directions for making up spray materials in apple Job 15.
7. Review principles of spraying in apple Job 16.
8. Why is Bordeaux used as a fungicide in summer spraying of apples while lime-sulfur is used on stone fruits instead?

Spraying Program for Peaches, Plums, and Cherries

Spray and Time of Application	Materials to Use	For Control of
Dormant Spray Winter and late winter	2% oil emulsion in 8-10-100 Bordeaux or 12½ gals. lime sulfur in 100.	San José scale and other scales and peach leaf curl. If scale is not present, use Bordeaux 6-8-100 or lime sulfur 7 gals. in 100 for curl.
First Summer Spray Seven to ten days after bloom when shucks are about half off	3 lbs. lead arsenate, 2 lbs. zinc sulfate and 3 lbs. of lime in 100 gals. of spray. (Zinc sulfate and lime reduce injury to fruit and foliage.)	Curculio, scab, and brown rot. If curculio is not serious, use 2 lbs. of lead and for brown rot add 6 lbs. flotation sulfur or commercial wettable sulfurs as recommended by the manufacturers.
Second Summer Spray Ten days after First Summer Spray	Use same materials in same proportions as for First Summer Spray.	Peach scab, brown rot, cherry leaf spot, and curculio.
Third Summer Spray Two to three weeks after Second Summer Spray	Use same materials in same proportions as for Second Summer Spray.	Brown rot, curculio, and cherry leaf spot.
Fourth Summer Spray Two to three weeks after Third Summer Spray	For curculio alone use 2 lbs. lead arsenate, 2 lbs. of zinc sulfate and 3 lbs. hydrated lime. If brown rot is threatening, add 6 lbs. flotation sulfur for each 100 gals. or use commercial wettable sulfur according to directions.	Curculio, brown rot, and cherry leaf spot.

NOTE.—Where San José scale and peach leaf curl are absent, the First and Second Summer sprays will generally be adequate for early peaches. For late varieties 2 or 3 additional sprays applied at intervals of about 12 to 14 days may be required. This will be particularly true during wet seasons when brown rot may be prevalent. It is important, however, that spraying be discontinued 2 to 3 weeks before harvest unless brown rot is serious, to prevent staining and marring the appearance of the fruit.

Job 14. Protecting Against Frost

Conditions Usually Found.—(1) In many regions frost occasionally destroys the fruit crop at blossom time. (2) Most growers do not try to prevent injury.

Aims.—(1) Students should learn the advantages of protecting blossoms against late frosts. (2) They should learn all methods and use the most economical.

Problems for Study and Discussion

1. What weather conditions cause late frosts?
2. What are the dangers resulting from frosts at blossom time?
3. Which of the orchard fruits are most commonly injured by late frosts?
4. At what stage of blossoming is frost most likely to be injurious?
5. About how often in ten years does frost kill fruit in your locality?
6. On what sites is frost injury most serious? Where least?
7. Why does a smoke or smudge prevent frost formation?
8. How may fires cause air circulation or wind in a hillside orchard?
9. Explain how wind prevents frost.
10. What materials could you find with which to produce a smoke or smudge in your orchard?
11. How may a wet-bulb and a dry-bulb thermometer, hanging together, help you in foretelling frosts?
12. How may weather-bureau records of late frosts aid you in foretelling frosts?
13. How can weather-bureau signals and other warnings be used by orchardists?

Review topics in Job 4.

Activities.—(1) Experiment with a pair of thermometers with wet and dry bulbs, as described in this job. (2) Try preventing frost by using smudges made from suitable materials.

Danger of Frost.—Stone fruits blossom early. Spring weather often turns cold after blossoming begins. Frosts may occur and kill the fruit crops. In many inland regions one crop of peaches in every four, on the average, is destroyed by frost. Near large bodies of water frosts are less likely to occur, for two reasons: the temperature is more uniform and the moisture in the air is apt to cause fogs or clouds.

Frost Conditions.—Heavy white frosts do not occur except when the air is still and clear, and the temperature of the air the evening before may be several degrees above freezing.

Black frosts are real freezes which form a skim of ice over water and may occur in any kind of cloudy or windy weather. Black frosts are not likely to occur after fruit trees are in blossom. If they do occur the injury to the pistils of the flowers is less likely to be serious because of the cloudy condition which allows the frost to escape from the tissues gradually the next day. Indeed, the greatest damage from any frost occurs from the rapid warming of the atmosphere after the freezing.

Smudges.—Heavy smoke prevents frost injury in three ways: by making a cloud which may prevent the frost, by preventing the rapid warming of the air the next morning, and by starting currents of air which may prevent frosts.

Smudges are produced in several ways (Fig. 108). Regular oil-burning pots are made which can be set at the intersections of the rows in the orchard. Crude oil or distillate is used with little expense. This method is sometimes called "orchard heating."

Heavy smoke may be produced by burning moist litter, as weeds, brush, damp straw, or cheap hay.

Foretelling Frosts.—A reliable thermometer will aid the orchardist to detect fall of temperature during the afternoon preceding a frost. Smudge materials may be made ready in advance and may be lighted about midnight if the frost is forming. Weather-bureau warnings may be received by telephone, radio, or special signals.

Wet- and Dry-Bulb Thermometers.—Two reliable thermometers hung side by side, one having a wet rag around the bulb suspended in a glass of water and the other dry, form a good combination for detecting

FIG. 108.—Oil pots used as "heaters" to prevent frost.

frost conditions. If the two thermometers read six or more degrees apart, there is more danger of frost than if they read nearly together. This is true because when the thermometers read farther apart the air is very dry and frost is more liable to form. If the dry-bulb thermometer is reading only a few degrees above 32 and the air is rather dry, frost is very sure to form unless the weather becomes cloudy or windy during the night.

Job 15. Harvesting, Grading, and Packing Fruit

Conditions Usually Found.—(1) The benefits of careful methods of harvesting, proper grading, and good packing are understood and secured by the best growers. (2) In some orchards mistakes are often made.

Aims.—(1) Students should understand the importance and the methods of careful harvesting, strict grading, and suitable packing of these fruits. (2) They should practise the best methods.

Problems for Study and Discussion

1. Ask growers how they detect proper maturity of peaches, of plums, of cherries of the different varieties.
2. What should be the differences in maturity of fruits to be shipped long distances?
3. Get good pickers to describe just how they handle the fruits when picking.
4. What kinds of picking vessels are best for each of these types of fruits?

FIG. 109.—Packing Early Richmond variety of cherries in Ohio. The rigid metal buckets used in picking prevent serious bruising of fruit. (U. S. D. A.)

5. Discuss mechanical graders for peaches; for plums.
6. Define the different grades and sizes for grading peaches; for plums.
7. What containers would you use for early peaches and plums?
8. What containers would you use later in the season if you changed? Why?
9. What containers do your best markets demand for cherries; for peaches; for plums?

Review Jobs 19 and 21 in the apple enterprise.

Activities.—(1) Practise harvesting these fruits with and without picking stands or ladders. (2) Compare different lots of fruit, graded and ungraded, in price received. (3) Collect all kinds of fruit packages used for packing stone fruits.

Judging Maturity.—For such perishable fruits as peaches, plums, and cherries the picker must learn to judge maturity accurately. Fruit for long shipments should be picked much earlier than fruit intended for a nearby market. Fruit has better flavor if left on the tree as long as conditions will warrant.

Changes of color form a good guide with most of the varieties. Pressure

with the fingers is another means of determining approaching maturity. Make a gentle pressure with the whole hand rather than dent the fruit with the points of the fingers or thumbs. With each variety and on each tree, the picker soon learns to know which fruits can be taken and which should be left. Usually most of the fruit is removed at one time for each variety. Pressure testers and sugar tests have been tried and may come into general use.

Care in Picking.—Bruising the fruit when picking is inexcusable. Good buckets or firm baskets lined with bags should be used to prevent

Fig. 110.—Picking baskets of this type help to protect the fruit from injury. Peaches are here being packed at an orchard station to start to market promptly. (New Jersey Station.)

mashing fruit. Therefore fruit should be handled with the hand in picking peaches and plums. The hands may move rapidly to hasten the job. Place each fruit individually in the picking vessel. Cherries should be handled by clusters, touching the stems only. The fruit should not be separated from the stems except with certain varieties in arid regions. Picking vessels for cherries should be filled to a depth of not more than a few inches, as they are liable to mash or be injured by punctures from the stems.

Mechanical Graders.—Many commercial growers picking fruit in an early stage find mechanical graders or sizers very advantageous for sorting peaches and plums into different sizes. Hand work is necessary for removing the blemished fruits, and for sorting as to coloration.

Fig. 111.—Picking and packing peaches in the Allegheny region.

Grades and Grading.—Peaches and plums are usually sorted according to size and degree of coloration within each variety. Two or three sizes are usually separated. All fruits of inferior size and all showing blemishes or presence of curculio are thrown into the culls.

Fig. 112.—Paper-lined berry boxes sometimes used for marketing plums.

Cherries are usually sold in one grade, but with some varieties more than one grade is selected. Cull out green fruits or any that have been injured in any way. The stems of cherries are usually packed downward. Each package is faced with the fruits on top (Fig. 109).

Containers.—Peaches and plums are usually packed in the early part of the harvest season in the six-basket Georgia carriers, each crate containing six one-gallon baskets. Later in the season, after prices drop, many growers pack the fruit in hamper baskets holding between one-half and one bushel each (Figs. 110 and 111). Cherries are commonly marketed in small vessels such as are used for strawberries. These are shipped in crates of about

24 quarts each. Some regions have special containers for plums (Fig. 112). In northern regions they are often sold in climax baskets of suitable sizes, as in the case of grapes.

For mid-western markets the so-called tub-bushel with flat bottom is much used for peaches, especially of the smaller sizes.

Job 16. Marketing and Using Fruits

Conditions Usually Found.—(1) Systematic methods of marketing commercial crops of fruit are becoming more common in many sections of the country. (2) Coöperative marketing is also increasing. (3) Poor methods of marketing are too commonly found.

Aims.—(1) The advantages and methods of good marketing, including coöperative methods, should be understood by growers. (2) Use of culled fruits and use of crops when prices are low should be understood.

Problems for Study and Discussion

1. When should containers be ordered for the forthcoming crop?
2. How can you judge the size of a fruit crop before harvest time?
3. Talk with local fruit growers regarding the advantages of coöperative shipping of fruit.
4. How could a fruit association aid in supplying containers for its members?
5. What effect would this have upon the surplus stock left over each season?
6. How can a good market manager aid fruit growers in selling their crops?
7. How can an association avoid overstocking any one market with fruit?
8. What is meant by selling to a buyer f. o. b.?
9. To what extent could cold storage be used for any of these stone fruits? (How long?)
10. What is meant by pooling the crop?
11. How may culled fruits and other cheap fruits be saved?
12. Review topics on marketing in apple Job 22.

Activities.—(1) Try to form a coöperative pool for selling a crop of fruit. (2) Make a wall chart enumerating the advantages of such a fruit association. (3) With the aid of folks at home use up low-grade fruit or low-priced fruit in canning or in other ways.

Buying Containers.—The problem of having containers ready at harvest time must be solved by each orchardist or by the association of which he is a member. The size of the crop can be judged better by an expert manager than by inexperienced growers. Orders must be placed several months in advance of harvesting.

A fruit association can more easily order the right number of containers than the separate orchardists of a region, as each would have to order separately a few surplus baskets and crates to be sure of having enough. The fruit association can supply all from a general stock and have only one lot of surplus baskets and crates left over. When a large order is placed it is often stipulated that surplus stock may be returned to the manufacturer. Some fruit associations manufacture their own containers. Any surplus stock may be kept till the next season by the grower or by the association if it is stored properly. It should be kept away from

wet, light, and dust. "Flat" crates of Georgia carriers not yet made up may be covered with suitable material in the loft of a packing shed until the following season (Fig. 113).

Coöperative Shipping.—A single crop is sometimes pooled by a number of growers without forming a permanent association. Each producer pays his share for having the fruit crated, inspected, and shipped to market. A temporary manager is selected who attends to the details of finding reliable buyers, answering all business correspondence, and dividing funds received from the sale of fruit.

A permanent association may accomplish many other purposes for its members. (See apple Job 22.)

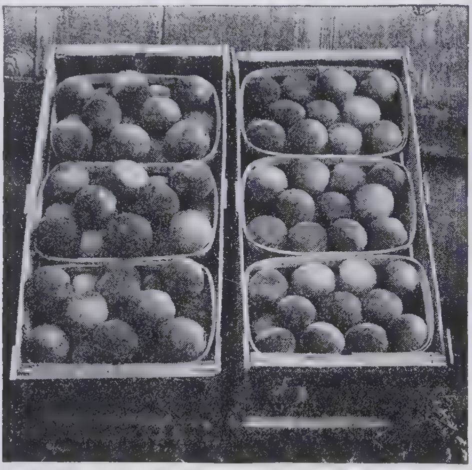


FIG. 113.—Two styles of packing peaches in Georgia carriers. Diagonal pack at left, popular with dealers. Flat and tight pack at right, fruit often bruised. (Michigan Station.)

Sales F. O. B. Tracks.—A number of neighbors who have pooled their interests on a single crop, and sometimes permanent shipping associations, sell their crop to buyers who handle it as it is loaded at the shipping station. The buyer requires that an inspector be present to supervise the proper grading, packing, and loading of the fruit in cars. Some type of refrigerator car is used for perishable fruits to be shipped long distances. The buyer pays the grower for the fruit delivered "free on board" cars.

Cold Storage.—Fruit growers within trucking distances of large cities sometimes use cold-storage methods to hold peaches, plums, or

cherries for a few weeks in order to avoid selling at the height of the harvesting season when prices are low (Fig. 114).

Using Surplus Fruit.—When fruits are sorted and packed for special markets, some are found which cannot go with the rest but should be used up in some other way. When prices of fruit are very low it sometimes pays to use the fruit for canning or for making butters instead of destroying it or trying to market it under adverse conditions. Over-

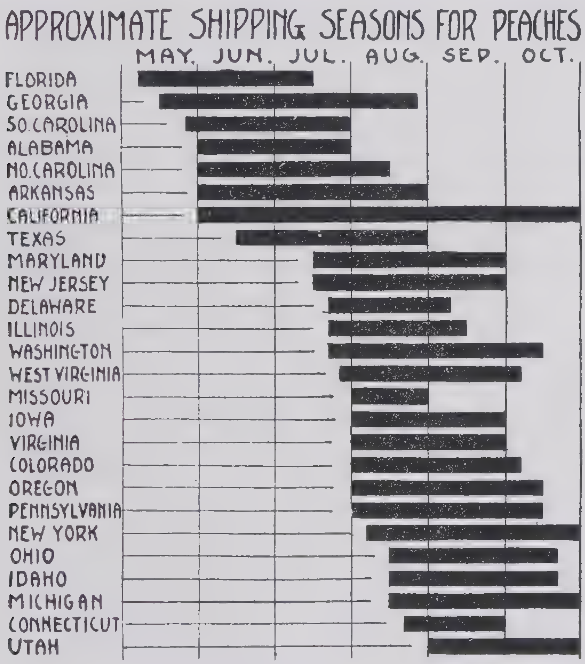


Fig. 114.—Shipping seasons for peaches from various states. (New Jersey Station.)

stocking the markets ruins the price. Local canneries are sometimes temporarily operated to use the surplus product. The cannery should be a separate organization if possible.

When an orchardist must handle his own surplus, methods of canning and making fruit preserves and fruit butters should be understood so that the products can be standardized. Much fruit may be saved and products sold later in the season if standard products are produced. Do not attempt to use culls and overripe fruits for canning except for home

use. They will not sell in competition with better canned products on the market. They may be used for making fruit butters and such materials.

Job 17. Keeping Records

(See forms in apple Job 23.)

CHAPTER IV

STRAWBERRY ENTERPRISE

Analysis into Jobs.—The following teaching units include the main operative and managerial jobs involved in the strawberry enterprise. The references are to U. S. Farmers' Bulletins. Secure local information from your own State Experiment Station. See also Fletcher, *Strawberry Growing*; Sears, *Productive Small Fruit Culture;* Shoemaker, *Small-Fruit Culture;* and Auchter and Knapp, *Orchard and Small Fruit Culture.*

1. Determining the possibilities with strawberries, 1026, 1027, 1028.
2. Choosing varieties, 901, 1026, 1027, 1028, 1043.
3. Propagating and buying plants.
4. Choosing the location and site for the patch.
5. Preparing soil and providing plant food.
6. Setting plants.
7. Cultivating and controlling runners.
8. Mulching strawberries.
9. Controlling enemies, 1458.
10. Renovating an old plantation.
11. Harvesting, grading and packing, 979, 1560.
12. Marketing and using, 1144, 1471, 1551.
13. Keeping records, 511, 572, 782, 1182.

Job 1. Determining the Possibilities with Strawberries

Conditions Usually Found.—(1) Many strawberry plantations are for home use only. (2) Commercial growing of strawberries is most common near large cities or in specially favored localities.

Aims.—Students should be able to decide on suitability of region, soil, uses, markets, capital and labor involved, and technical knowledge required.

Problems for Study and Discussion

1. To what extent are strawberries grown for home use only in your region?
2. How much is the crop grown for market?
3. What reasons are given by farmers for not growing strawberries commercially?
4. How difficult do growers find the labor problem at busy seasons?
5. What soils of your region are best suited to strawberries?
6. What crops should strawberries follow in rotation on your farm?
7. What do farmers say regarding the price and yields of berry crops?
8. Ask farmers the cost of buying the plants and setting an acre.

Regions.—The strawberry is grown in all the humid parts of the United States (Fig. 115). It requires considerable moisture and should not be grown where the rainfall is very light unless irrigation is provided.

Soils.—The best soils for growing strawberries are light sandy loams

or medium sandy loams. The clay soils also produce the strawberry well, but if dry weather follows heavy rains, the soil will bake and the yield will be greatly reduced.

The heavy soils may be made more suitable for strawberries by a heavy application of manure. This will add organic matter and loosen the soil. The addition of lime will also flocculate the soil and make it more porous. If lime and manure are both added to heavy soils, the results will be very favorable to strawberries.

Location.—It is well to have the strawberry plantation in a sunny exposure where there is no shade from trees. Near the main residence

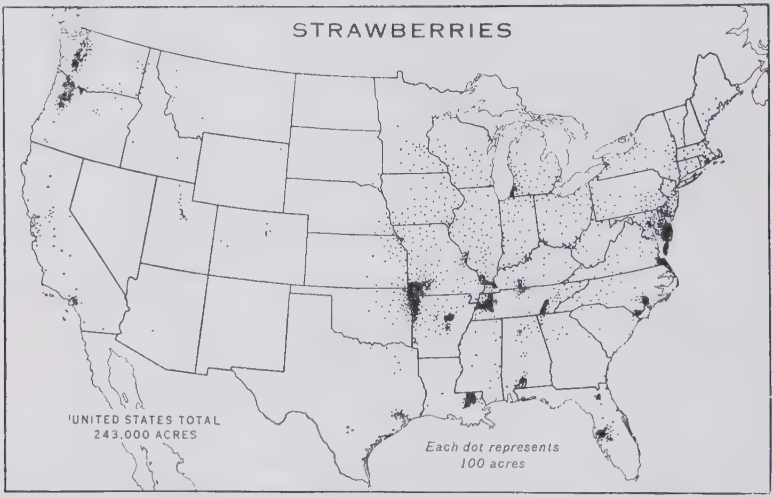


Fig. 115.—Strawberry acreage in the United States according to the last census. Strawberries are grown in nearly every state. They are intensively cultivated for shipment largely to northern markets in several localities along the Atlantic Coast and in the lower Missouri and Mississippi Valleys. Important centers of production are also located in the Pacific Coast States. (U. S. D. A.)

is a good place. Cultivation and picking should be done at the right times, and a long distance might cause neglect. The crop is more easily protected from marauders if the patch is located near the home.

Labor and Investment.—Good plants can generally be obtained for three dollars a thousand and upward. About five thousand plants are required to set an acre.

The work of setting and cultivation are important labor items but the most strenuous labor problem comes at harvest time. Many pickers must be employed. As these are usually paid by the quart or gallon, the labor will always pay for itself; but how to provide help must

be studied by the grower before planting the field. Men, women, and children can be employed for this purpose.

Yields and Prices.—Growers usually find strawberries selling at satisfactory prices, but occasional reverses are encountered. The early crop may sell for about three or four dollars a crate net to the grower above cost of grading and marketing. Later in the season the price may drop to one dollar or even less.

Yields vary greatly in different seasons and with different varieties. The average for the whole United States is about 3000 quarts per acre. This is frequently doubled by the best growers.

Choosing the Field.—Strawberries should not follow directly after a pasture or meadow crop without a cultivated crop intervening, preferably for two years. The grower should choose a field with plenty of organic matter in the soil but free from fresh organic matter containing grub worms, as this enemy may attack strawberry roots seriously. See Job 4. There is some danger in planting strawberries after a crop of corn in which wire worms have been working, since they may attack the strawberry plants.

Job 2. Choosing Varieties

Conditions Usually Found.—(1) Commercial growers usually choose varieties suited to their soils and to their market conditions. (2) For home use varieties are chosen to suit the taste rather than for their productivity or shipping quality.

Aims.—(1) Students should study varieties and their adaptation to certain regions and soils. (2) They should know which ones are best for home use and which for market. (3) They should know what varieties require planting near other varieties to provide for cross-pollination.

Problems for Study and Discussion

1. Inquire of neighbors as to which varieties are most popular in your region and why.
2. Make a list of the best varieties of strawberries, arranged by seasons.
3. Which of these varieties are best for home use, and why?
4. Which of them are good for commercial plantations?
5. Give examples of differences between home and commercial requirements.
6. Ask growers which of these varieties seem to be most resistant to disease.
7. Give reasons why you should not plant untried varieties described in catalogs.
8. What new varieties have been tried in your neighborhood? With what results?

Activities.—(1) Study varieties of strawberries in the markets. (2) Study the characteristic growths of different varieties in fields.

Varieties of Strawberries.—Each locality favors certain varieties of strawberries. It is easy to make a selection of several varieties that will thrive in a particular region.

There are two kinds of strawberry blossom. Some varieties have only the pistillate blooms, while others have perfect blossoms with both stamens and pistils. Those with perfect blossoms have the power to pollinate them-

selves and bear fruit without the proximity of other varieties. Varieties with imperfect flowers, such as Howard Supreme, and Sample, which have few if any true stamens and no pollen, must be grown near other varieties which blossom at the same time and bear perfect flowers. The pollen from the perfect-flowered varieties will fertilize the others and fruit is produced.

The two kinds may be planted in alternate rows, or with one row of perfect flowers to each three or four of imperfect flowers.

It would be a good plan to select such varieties for planting as are grown successfully by others in the same locality on the same kind of soil. Do not select new varieties until they have been reported favorably by the experiment stations or by other experimental growers. Write to the state

Fig. 116.—A cluster of Premier strawberries. Premier is a very good early variety. It is productive on most soil types and is considered resistant to spring frosts. (Courtesy O. A. D. Baldwin, Bridgman, Michigan.)

experiment station for a list of varieties which are suited to your region. Popular varieties used in many parts of the country are (1) Excelsior, Dunlap, and Premier; (2) Klondike and Missionary; (3) Chesapeake, Aroma, Sample, and Gandy. These groups are numbered in the order of their ripening. Others popular in certain sections are Marshall, Blakemore, Clark, and Mastodon (everbearing). New varieties of promise include: Dorsett, Fairfax, Catskill, Redheart, and Rockhill or Wayzata, Gem, and Green Mountain (everbearing).

Commercial Varieties.—A good variety for use in a commercial plantation should meet the following requirements: (1) It must be firm enough in texture to stand shipment well. (2) Its color, form, and size should give it a good appearance to the buyer when boxes are on display. (3) The yields must be abundant or at least satisfactory. (4) The choice

should agree with the variety grown in the neighborhood so that coöperative shipments can be made when desired. (5) It should be resistant to disease and insects as far as possible and stand up well in the field under unfavorable weather conditions.

Three Varieties.—For a commercial plantation three varieties should be enough. One of these may be very early, the next medium, and the other late. In some regions late varieties only are profitable, while in others early varieties are most profitable. The latitude, and long distance shipments of berries from other localities will largely determine this choice.

Resisting Diseases and Insects.—Some varieties are more resistant to strawberry weevils than others. Those bearing an abundance of pollen are bothered most by this enemy. Some growers find it necessary to grow mostly pistillate varieties to avoid the weevil. Leaf spot and "yellows" are more serious on some varieties than on others. Experimental trials are being made to solve this problem.

New Varieties.—Do not try new varieties on a large scale until your experiment station recommends them. Everbearing varieties of strawberries are constantly being offered on the market. These usually bear so few berries at a time that they are unprofitable for commercial plantations. They should be classed as novelties and grown for home use only. Some form of irrigation is necessary where everbearing sorts are grown successfully.

Job. 3. Propagating and Buying Plants

Conditions Usually Found.—(1) Growers often propagate their own plants. (2) Others often buy their plants from neighbors or from nurseries.

Aim.—Students should learn to manage a propagation bed and how to produce and choose the strongest plants.

Problems for Study and Discussion

1. Who in your locality usually buy their plants from neighbors? Who buy from nurseries?
2. What difficulties have any of them found in procuring plants by these methods?
3. Choose the method of procuring plants which you would follow for strawberries and give your reasons.
4. Describe the management of a strawberry propagation patch.
5. Get examples of good and poor strawberry plants and compare them.
6. Tell how to choose good strawberry plants from a bed which is to be plowed under.
7. At what time of year would you save plants from an old field?
8. How can plants be stored temporarily if old fields are plowed at a time when planting of new fields cannot follow immediately?

Activities.—(1) Collect specimen "runner" plants set at different distances from "mother" plants and compare them in vigor and size. (2) Compare average plants from regular propagating beds and from fruiting beds.

Securing Plants.—Strawberries naturally propagate themselves by runners. In taking plants from an old setting the strongest and most

vigorous plants free from insects and diseases should be selected. Those with thick crowns will produce much more growth the first year than those having only one bud at the crown. When plants are purchased care is necessary to get the best.

FIGS. 117 and 118.—Strawberry plants should be cared for promptly when received. Below, ready to be heeled in. Above, unpruned, pruned, and single plant of Dunlap variety. Root pruning is seldom advisable except as an aid in setting with a transplanting machine. (Kentucky Station.)

Propagating vs. Buying Plants.—In regions where strawberries are commonly grown, the plants are usually secured from neighbors or from the grower's own fields. By this plan the grower is usually certain of having plants true to name. He may know that they are free from nematodes or other serious troubles. He may not need to pay out money for them. He can usually get plants just when he needs them. Such plants,

however, may be weakened from allowing the mother plants to bear fruit and may be infected with leaf spot or infested with root louse or crown girdler.

The advantages of buying plants from a good nursery are that the plants will be stronger if grown for propagation only and that they have been inspected for insects and diseases. A new strain or a new variety may be secured if desired.

A Special Propagating Bed.—Nurseries usually grow strawberry plants for propagation in fields not used for fruit production. The blossoms are kept picked off, good culture is given, and the runners are allowed full scope. This tends to produce stronger crowns and vigorous plants and varieties true-to-name. It is desirable that stock be obtained from runners of the same or previous season. The plant should have a healthy top with a strong and vigorous crown and root system. The roots should be light in color. Too many black roots indicate that the plant is old and unfit for planting.

Holding Plants.—Plants received from a nursery or procured from an old field at some time before time to plant them in the new field may be held for a few weeks when laid in ditches or heeled-in (Figs. 117, 118). In this operation each bundle of plants should be opened if received from a nursery, or the plants well separated if secured near by, and spread out in the trench, allowing the moist earth to come in contact with the roots. This precaution is highly important. Then firm the earth carefully about the roots. Water the plants unless the moisture supply is adequate. Do not cover the crowns. They may be pruned at the time they are dug or at the time of heeling-in.

Job. 4. Choosing the Location and Site for the Patch

Conditions Usually Found.—(1) Sometimes the strawberry patch is located unfavorably. (2) Most patches for home use are placed where they will be handy rather than with respect to other considerations. (3) Locations for commercial fields are usually considered carefully.

Aims.—Students should learn to locate a site well and decide what crops are best for strawberries to follow.

Problems for Study and Discussion

1. Look at several strawberry patches, and decide whether a better location could have been found near by.
2. Ask growers which they consider more important, handiness or suitable soil.
3. Ask also which they consider more important, favorable air drainage or proper exposure.
4. How many growers have had strawberry crops injured by late spring frosts?
5. Consider northern and southern slopes with respect to patches for home use and commercial plantations where earliness is important.
6. What farm crop is best for strawberries to follow?
7. What enemy is serious when strawberries follow grass or other sod crop?

8. What factors are involved in choosing the size of field to plant?
9. What type of soil in your region is best for strawberries?

The proper choice of the particular piece of ground upon which strawberries are to be grown is extremely important. Even the best of later care will not compensate for the choice of a site which lacks the requirements necessary for successful strawberry culture.

Air Drainage and Exposure.—In many strawberry regions danger from late spring frosts is a very serious problem. A southern slope will hasten the blooming season and in unfavorable years some killing of blossoms may result. Northern exposures tend to delay the blossoming and also delay the crop. Commercial growers desiring an early crop are usually willing to risk a southern exposure in order to get the crop to market earlier.

Many strawberries are grown without air drainage. More attention should be paid to the selection of a site with air drainage. There is more danger of frost on a level field than on a slope, even if it is a southern exposure.

Following a Suitable Crop.—As stated in Job 1, the strawberry field should follow a cultivated field rather than heavy sod. It is very important that a field long occupied by a sod crop should not be used for strawberries. It is likely to be badly infested with grub worms, which are the larvæ of June beetles.

The soil should be well supplied with organic matter, and if a heavy sod has been plowed under one or two years before planting strawberries, with either a hold crop or a green manure crop intervening, the grub worms may have been destroyed or hatched out.

The Best Local Soil.—Strawberries should have a favorable soil for production of heavy crops. If earliness is important, light soils are better than heavy ones. If summer drouths are serious in your region, especially if you have no facilities for irrigation, heavy soils may be chosen in preference to light ones.

Job. 5. Preparing Soil and Providing Plant Food

Conditions Usually Found.—(1) Many people fail to plan long enough in advance for a fruit plantation. (2) Many partial or total failures are found because the soil was not well prepared before planting.

Aims.—Students should learn to prepare soil so as to have it free from insects, plant diseases, and noxious weeds, to supply it with vegetable matter and plant nutrients, and to have the soil in good condition for planting.

Problems for Study and Discussion

1. How do local growers provide plenty of organic matter in the soil for strawberries?
2. What crop should strawberries follow to avoid danger of grub worms?

3. How long in advance would you have to plan in order to grow a green-manure crop to turn under for strawberries?
4. What plants would you grow in your region for this purpose?
5. How do local growers prepare the soil for planting?
6. Compare deep plowing with shallow plowing under different conditions.
7. Should the soil be well settled before planting time or should it be loose? Why?
8. Ask farmers to what extent their strawberry plantations suffer from drouth.
9. Suggest ways of causing a soil to hold moisture better.
10. How can heavy soils be made lighter? Light soils heavier?

Heavy Manuring.—On most soils it is almost impossible to apply too much organic matter. Some growers apply as much as thirty or forty loads of barnyard manure per acre before planting strawberries. A heavy sod will supply much organic matter. It should have time to rot well and for grub worms to hatch.

A green-manure crop free from grub worms may be grown by starting a cover crop about August. This may be plowed under in the spring in time to prepare the soil well for the spring planting of strawberries. Grub worms will not infest a winter cover crop, as the eggs are laid mostly in late spring or early summer on other sod crops. A suitable crop for this purpose would be winter rye and vetch, or in mild climates crimson clover and rye. Sweet clover is recommended in some sections.

Preparing the Soil.—If heavy applications of manure have been made, plowing should be rather deep. The surface should be thoroughly disked in order to incorporate the organic matter with the soil and to prevent shutting off capillary moisture from below. The strawberry bed is to be left unplowed for two or three years after the plants are set, so thorough plowing and good preparation previous to that time give best results.

The surface should be harrowed several times so as to sprout many weed seeds before the planting of strawberries. A rather firm bed is preferable to a loose open soil. Strawberry roots are fine and should come in close contact with soil which has been packed or has had plenty of time to settle after plowing.

Protection from Drouth.—In regions where strawberries suffer from drouth, heavy soils or those containing an abundance of well rotted organic matter are certain to hold more moisture than light soils. A heavy soil may suffer from drouth because of baking and cracking. The presence of plenty of organic matter tends to prevent this bad condition. Light soils tend to dry out rapidly. They may be improved by adding plenty of organic matter and allowing it to rot well. Strawberries need much available moisture for growth during the summer season when the buds are being formed for the next spring's crop. Suffering in the summer will greatly reduce the next crop.

The Use of Lime.—An application of limestone at the rate of about 2 tons to the acre will often pay for itself in bringing about an improvement in the texture of extremely light or extremely heavy soils. Aside from this effect, its special value is probably not due primarily to neutralization of acidity but rather to its reaction with the other plant-food elements in bringing about more favorable conditions for plant growth.

It is commonly believed, however, that strawberries prefer a somewhat acid soil. The advantages from liming can usually be secured with little apparent injury by applying the crushed limestone at least one season previous to setting the strawberry plants.

Job 6. Setting Plants

Conditions Usually Found.—(1) Experienced growers have little difficulty in setting plants well. (2) Beginners often make mistakes in this job.

Aim.—Students should learn the art of setting plants properly.

Problems for Study and Discussion

1. At what time of year do local growers usually set strawberry plants?
2. What condition of weather do they prefer for this?
3. How are plants handled before setting?
4. What plans are followed in setting strawberries—hedge-row, hill system, or matted-row?
5. Get opinions of local growers regarding these three methods of setting strawberries.
6. Make a list of the points in favor of the hedge-row over the matted-row.
7. Make a list of points in favor of the matted-row over the hedge-row.
8. Study possibilities of the spaced-row method.
9. Calculate the number of plants required to set an acre of strawberries.
10. How deep should strawberries be planted?
11. Describe the dibber method of planting.
12. Describe the furrow method.
13. Give the distances for planting.
14. Under what circumstances would you water the plants?

Activities.—(1) Practise setting strawberry plants by different hand methods and compare results. (2) Students may contest with each other in setting plants, comparing speed and quality of work.

Three Plans of Setting Strawberries.—Far the most common method of growing the strawberry is known as the matted-row system. In this plan the plants are set about twelve to eighteen inches apart in rows four feet apart. The runners from these plants are allowed to take root in all directions until a rather solid mat is formed, two feet wide (Fig. 119). This leaves a space for cultivation between the matted rows of about two feet. The weeds growing in the matted rows are pulled by hand.

The hedge-row system (Fig. 120) is coming more into use in nearly all parts of the country where it has been tried. By this plan the plants are first set in rows about three feet apart and are allowed to set their runners

only in a narrow row forming a dense "hedge." The runners extending outside this middle space are cut off by a wheel cutter, hoe, or spade. The entire middle is thoroughly cultivated and all of the strength of the plants is forced into the crowns, blossoms, and fruit.

Fig. 119.—Strawberries grown in narrow, matted rows with straw mulch between. (Indiana Station.)

Fig. 120.—Strawberries in narrow hedge-rows three feet apart. The straw mulch saves moisture in the soil, keeps the berries clean, and keeps down the weeds.

The hill-row system (Fig. 121) differs from the hedge-row system in not allowing the runners to reach out in any direction. The plants are set in rows both ways about three feet apart each way. Cultivation is given in both directions. The plants attain stronger crowns by this method than by any other. Of course the number of plants per acre is smaller.

FIG. 121.—Strawberries grown according to the hill-row system. The plants in rows in two directions allow cultivation on all sides of each plant. Cultivation takes place after harvest when the mulch is removed. (Indiana Station.)

The student should compare the advantages of the three systems. The principle should be kept in mind that plants which allow runners to form continuously will not make strong crowns or bear as much fruit to each plant as others. The hedge-row and hill-row plans allow of more mulching, as the mulching of the matted-row must be removed in the spring to allow the crop to form. In the other two plans the mulch may remain between the rows until after picking. The fruit clusters may form upon it and are thus kept out of dirt. This mulch keeps down the weeds, conserves moisture, and makes picking more agreeable. After the crop is all gathered the vines are mowed down, raked off with the mulch, and put into the compost heap.

The spaced-row system is another modification. It is being used successfully with vigorous varieties, such as Blakemore, which throw so many runner plants that crowding occurs and the crop suffers. The surplus plants are "strawberry weeds" in effect.

Spacing is used to prevent the rows from becoming heavily matted. The *first* runner plants are encouraged to set as early as possible. When the row reaches the desired width, the *later* runners are kept from rooting by either cutting or raking them out. Depending upon local conditions and varieties grown, from 4 to 8 runners may be allowed to take root to the square foot with these plants spaced up to about 9 inches apart. (See figures 121a and 121b.)

Number of Plants to the Acre.—In estimating the number of plants to the acre the distance between the rows in feet is multiplied by

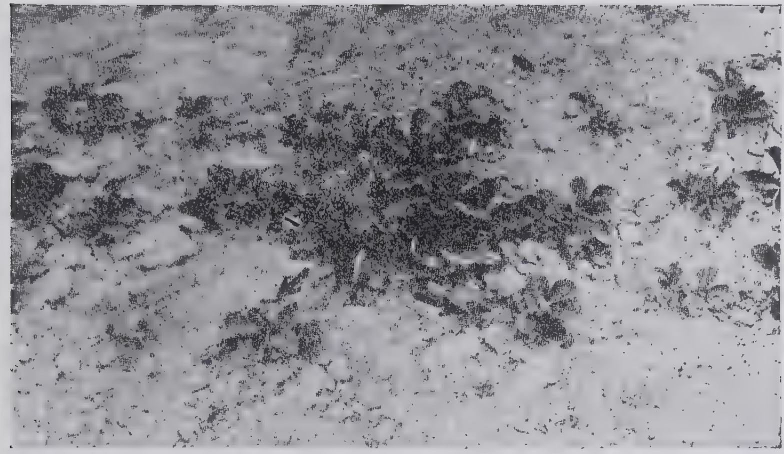


FIG. 121a.—Starting the spaced row. An attempt is being made in this row to space the runner plants about 7 inches apart. The arrows indicate runners recently set from the mother plant in the center. (Courtesy W. F. Allen, Salisbury, Maryland.)

FIG. 121b.—Strawberry plants growing under the spaced-row system. The plants in this patch are large and healthy with well-developed crowns, and promise a heavy crop of fruit. These productive rows are the result of good care during the previous growing season, including proper spacing of runner plants and removal of runners after the rows had been sufficiently filled. (U. S. D. A.)

FIG. 121c.—Setting plants with a spade. (1) With the ground properly prepared and a corn wire marking the row, a shiny spade (to which the dirt will not stick) is inserted and pressed down to about half its length, making a flat opening. (2) As the spade is carefully removed so that no soil falls back into the opening, a plant is set with its roots spread out in fan shape and its crown a trifle above ground level. Next (3) the spade is inserted a short distance from the plant and soil is pressed about it, completely filling the opening. Finally (4) the soil is pressed with the foot carefully but firmly about the plant, leaving its crown level with the ground. (Illinois Station.)

the interval between plants in the row, and the number of square feet in an acre (43,560), is divided by the product.

Setting Plants.—Setting the plants at the right depth is important. The crown must not project above the ground and it must not be covered beneath the surface. Have the roots and the base of the crown well protected by soil which is well packed about the crown. Plants will not grow if the crown is covered.

The dibber method of planting is very rapid, but the roots are not as well spread in the soil as by the furrow method. Two persons may work together in using the dibber method. One makes the opening and presses the dibber forward. The other places the plant in the hole and holds it at the proper depth until the first workman presses the soil back against the roots. A spade may be used in place of a dibber (Fig. 121c).

The furrow method consists in opening a furrow with a small turning plow or bull-tongue plow. The plants are then distributed a short distance ahead of the setter. The setter spreads the roots, and plants each plant at the proper distance by holding, firming the soil about the plant as he goes.

Transplanting machines, such as are used for cabbages and tobacco, are sometimes used for setting strawberries. The results are satisfactory provided the operators are careful regarding the depth of setting. An important advantage of the planting machine is the facility with which it waters the plants. In dry weather this is very important. Planting can be done quickly when soil and weather conditions are most favorable.

Job 7. Cultivating and Controlling Runners

Conditions Usually Found.—(1) Commercial fields are usually better cared for than others. (2) Strawberry patches are often neglected after picking time.

Aims.—(1) Students should understand the best methods of economically cultivating and controlling runners. (2) They should study the possibilities of irrigation.

Problems for Study and Discussion

1. Ask local growers to give their annual cultivation plan for strawberries.
2. What difference in the annual cultivation would be found between a strawberry patch grown by the hedge-row, the matted-row, and the spaced-row?
3. What reasons are given by growers who do not practise clean cultivation after harvest time?
4. Compare fields where there is clean and thorough cultivation during the last half of the summer to see if they have better fruit the next year than others.
5. What economical methods of cutting runners may be used?
6. Why should the runners of a young patch be moved into the rows? When should this operation cease?
7. Why should cultivation be continued until late fall?
8. What implements may be used for cultivating strawberries?
9. Should fertilizers be used in growing strawberries?
10. Can water be applied profitably to increase production?

Activities.—(1) Make a straight "scuffle" hoe by straightening a common hoe to use in cutting runners. (2) Sharpen a wheel cutter or rolling coulter and mount it for this work. (3) Use different cutting devices and compare them. (4) Try different methods of irrigation if water can be secured.

Cultivation of Strawberries.—The plants respond readily to thorough cultivation. The more tillage given to the patch, the better the plants will grow and the larger will be the yield. Cultivation in the matted-row is very limited and does not come close to any plant but at the edges of the rows. The soil is apt to become hard and baked as the strawberry takes its moisture from the soil. In regions where grass tends to grow, considerable handwork and hoe work may be necessary. Clean cultivation with no weeds and grass should be the rule.

In the matted-row system where a mulch is not used, one cultivation or more is often given the crop in early spring before the picking of fruit. When mulching is practised, cultivation usually does not occur until after picking is over. In either case the cultivation should continue as long as weather is favorable for growth. This may be until late fall. The more growth the plants produce during the summer and fall the better for the next crop. Keep down weeds to conserve moisture.

Suitable implements for cultivation between the rows are those which are usually used in the same region for cultivating corn. Deep tillage is not important and may do some injury. Avoid ridging of the rows, as level culture is considered more satisfactory. An exception to this rule may be found in windy regions.

Strawberry plants and fruits suffer from short periods of drouth. Irrigation has been found a very profitable practice where water can be secured at a reasonable cost. Three methods of watering are: surface or ditch, overhead, and canvas hose irrigation.

Cutting Runners.—Wheel cutters are best for cutting runners. Two wheel cutters may be fastened to the sides of a one-horse cultivator in such a way as to cut the runners on both rows. These wheel cutters may be made from circular saws sharpened on the edges or may be rolling coulters taken from turning plows. Hand methods of cutting are used by some growers. The runners should be cut on hedge-rows three times each summer. This is also advisable on matted and spaced rows after they have spread as wide as desired. Fig. 121d illustrates a cultivator with rolling cutter.

Fertilizing.—The strawberry plant may be said to be a ravenous feeder. It requires a great deal of nourishment and will respond to heavy feeding. The best form of plant food is supplied by adding barnyard manure. Some soils can be fertilized for the strawberry crop as heavily as twenty tons of barnyard manure to the acre.

Fig. 121d.—Spring-tooth cultivator with rolling cutter. This home-made tool does very efficient work in cutting out surplus plants and weeds between the rows. (Illinois Station.)

Fig. 121e.—Spreading a mulch of wheat straw on a large plantation. The mulch is applied to a uniform depth of about 2 or 3 inches after the plants have become dormant. (Illinois Station.)

A good plan for applying barnyard manure is to plow it under at two different times before setting the plants. Apply half the manure, turn it under, then apply the remainder and turn under by plowing crosswise of the first plowing. This will incorporate the manure in the soil. Commercial fertilizer cannot replace humus-forming manures.

If commercial fertilizers are used, bone meal and tankage are good forms. Many growers give the plants an application of nitrate of soda, from 100–250 pounds to the acre, just after the picking season is over and the patch has been cleaned up thoroughly. Some growers find that 200 pounds of superphosphate (acid phosphate), applied either early in spring as growth begins or at the time of renovation in summer, increases the yield the next season. Some use a complete fertilizer.

Job 8. Mulching Strawberries

Conditions Usually Found.—(1) In the most progressive strawberry-growing sections protection by mulching is very common. (2) Mulching is usually heaviest when the field is set according to the hedge-row system.

Aims.—Students should learn the benefits, disadvantages, and methods of mulching strawberries.

Problems for Study and Discussion

1. Of what value is winter mulching in retarding the blossoming season in the spring? In protecting the crowns during the winter?
2. Describe good methods of mulching strawberries in late fall and early winter.
3. When should the mulch be removed or opened for new growth?
4. What are the advantages of allowing the mulch to remain between the rows of strawberries during the picking season?
5. Compare different materials in suitability for mulching strawberries.
6. How may weeds be started by the use of mulch?
7. Compare berries of the same variety at picking time from fields with and without mulch.

Activities.—(1) Conduct trials with projects to compare several different mulching materials for strawberries. (2) In like manner compare different depths of mulching.

Materials for Mulching.—Straw is the commonest and best mulching material (Figs. 119, 120, 121, 121e). Marsh hay or other low grades of grass and pine needles are sometimes used. If weeds or hay containing mature seeds or poorly threshed straw are used, they are likely to scatter seeds in the field. Corn stalks which have been grown close for the purpose may be satisfactory (Fig. 123). It is more difficult to remove stalks from the row and leave them properly placed between the rows until after the picking season. In windy regions growers sometimes use a light application of straw or grass and throw a few stalks on top.

Time and Depth of Mulching.—The best time to mulch a strawberry field is when cultivation is over and the plants have become dormant (Fig. 121e). Some growers prefer to have the ground freeze hard and then

cover the plants well to hold this frozen condition if possible throughout the winter. Plant crowns may be injured if air temperatures suddenly drop too low.

If the mulch is applied early, the first application should be light to avoid smothering the plants and causing decay of leaves. As cold weather comes on, more mulch may be added.

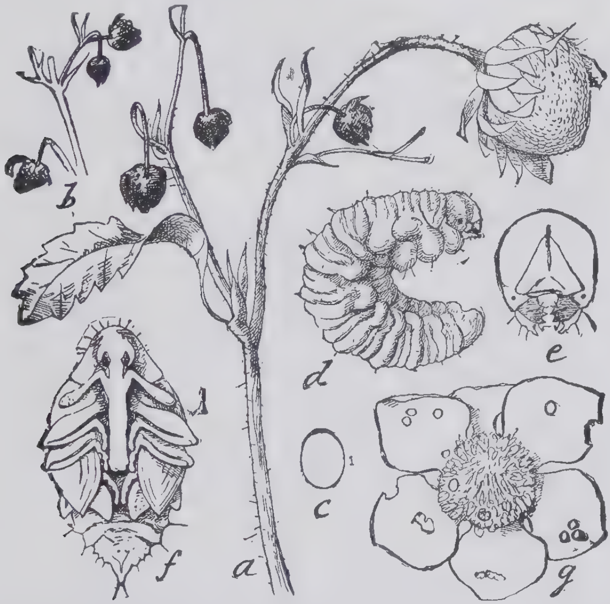


FIG. 122.—Strawberry weevil and its work. *a* and *b*, strawberry fruit stem showing the effect of bud cutting; *c*, egg of weevil; *d*, grub; *e*, head of grub; *f*, the pupa or stage into which the grub transforms when matured; *g*, injured bud opened up. (U. S. D. A.)

Depths of mulching vary greatly with growers who use the different systems and different materials. In northern climates three or four inches of good straw, closely packed, is not too much. In milder climates less material is used.

Removing the Mulch.—Lifting the mulch from the plants and moving a portion of it to the middles of the rows should take place just before the time for the formation of blossoms. In regions where late frosts are likely to injure the crop the removal of mulch may be delayed until the new plant growth begins to show light in color. If the weather becomes warm and remains so for several weeks before the mulch is removed, the plants will be seriously injured.

At first the mulch is just scratched apart a little to allow the plants

to come through. It is left between the rows as a protection to the fruit until after picking time. It keeps down weeds, conserves moisture, makes picking more agreeable, and keeps the berries clean. There are fewer gnarly berries when the fruit is protected by such a mulch. This may be because heavy rains do not spatter dirt upon the growing fruit.

Job. 9. Controlling Enemies

Conditions Usually Found.—(1) A few diseases and insects are likely to be very serious. (2) Some farmers fail to combat these natural enemies successfully. (3) Experienced growers seldom have heavy losses from these enemies.

Aims.—(1) Students should learn the dangers from attacks of diseases and insects. (2) They should learn how to recognize and to control each of these successfully.

Problems for Study and Discussion

1. Ask local growers what enemies have been serious on strawberries.
2. Look up the best methods of preventing or fighting each of these.
3. What diseases and insects are considered serious in other regions?
4. Describe the injurious results from enemies which are serious locally.
5. Estimate the loss which does or might occur from some of these.
6. Estimate the cost of fighting or preventing them.
7. Compare dusting with spraying for strawberry weevils or other biting insects.
8. Give directions for preparing a nicotine spray for fighting sucking insects.
9. For what diseases is Bordeaux mixture used on strawberries?
10. Why is it used in advance of the attack?
11. Review directions for preparing Bordeaux mixture.

Activities.—(1) Spray most of a field as it should be with Bordeaux mixture, and leave a small part not sprayed to compare results. (2) In like manner dust for weevils, using materials suggested, leaving a check plot to compare results.

Strawberry Weevils.—These are usually the worst insect enemies of strawberries. They are about 1/10 inch long. The females lay their eggs on fruit blossoms or fruit clusters in the early stage of development. They then bite the fruit stems enough to cause them to droop. This prevents further development of fruit. These attacks sometimes ruin the crop (Fig. 122).

Control.—The winter is passed in the soil, and clean cultivation is considered a good method of fighting the enemy. Weevils feed upon pollen from strawberry blossoms. They are therefore found more abundantly upon varieties which bear much pollen. The pistillate varieties are seldom attacked seriously. Growers sometimes plant pistillate varieties in regions where weevils are abundant, with only enough pollen-bearing varieties to pollinate the field. One row of staminate plants for every four to five pistillate rows is enough. The fighting of weevils can then be confined to the staminate rows.

Dusting or spraying with arsenate of lead is very successful. Mix one pound of arsenate of lead with five or six pounds of flowers of sulfur

or with lime to use as a dust. Apply this at the very earliest appearance of any weevils in the field. Repeat if necessary about two weeks later. Spraying is more expensive because of the labor involved, but some growers practise this. They use one to three pounds of arsenate of lead in fifty gallons of water. If diseases are present this poison may be mixed with Bordeaux mixture, and the weevils will be controlled in fighting the diseases.

Plant Lice.—These enemies are not common on strawberries, but when present may be controlled by a nicotine spray, using nicotine sulphate, one part to 800 of water.

Strawberry Leaf-Rollers.—These insects are often found in the strawberry patch, especially after it has been fruiting one or more years. The small greenish brown larvæ roll one portion of the leaf over upon the other and feed within this protecting fold. The leaves turn brown and die, with considerable injury to the plant as its leaf surface is cut down.

Spraying for their control must be done before the larvæ have begun to protect themselves within the leaves. An application of three pounds of arsenate of lead in 50 gallons of solution just as the first blossoms appear is effective. At least 100 pounds pressure should be used in spraying in order that the poison shall reach all the folds of the leaves.

The operations of burning and cultivation followed in the renovation process are also helpful in the control of these insects.

Diseases of Strawberries.—Several leaf diseases attack this crop. The leaf spot or blight is probably the worst. Yellow spots appear on the leaves, which enlarge and finally destroy the leaves. The vigor of the plants is greatly reduced and the crop is much less than from healthy plants.

Leaf spot and other diseases and some insects may be kept under control fairly well by mowing down the plants immediately after picking is over. Use a scythe or mowing machine the very day the last picking is done for each variety. Rake off the tops with the mulch and burn all trash. If care is used the tops may be raked to the middles and the field burned over on a windy day, preferably after a rain, when the ground is moist. Such clean-up methods are very satisfactory if cultivation follows immediately.

Instead of burning the vines, they may be hauled off and put into a compost heap some distance away to rot and be used on corn or other crops. Never return such material to the strawberry field.

Spraying with Bordeaux mixture against strawberry diseases is sometimes practised with good results. (See preceding topic.)

Job 10. Renovating an Old Plantation

Conditions Usually Found.—(1) Strawberry plantations are often renovated after the second or third heavy crop. (2) Many successful growers prefer planting new fields to renovating old ones.

Aims.—Students should learn good methods of renovating or rejuvenating strawberry plantations.

Problems for Study and Discussion

1. Study a good local method of renewing an old strawberry patch.
2. Make a drawing to describe the system followed.
3. Compare results from renovated beds with those from newly set beds. Which bear first?
4. Which bear heaviest?
5. Which are less affected with diseases and insects?
6. Which are less weedy?
7. Which are more uniform in size of berry and date of ripening?
8. Estimate the cost of renovating an old bed and compare with the cost of setting the same area in a new place.

Activities.—(1) Compare items of cost and yields from a renovated bed with those from a bed properly started anew. (2) Compare two methods of renovation of beds.

When to Renovate.—Strawberries are expected to bear only two or three crops. If the plants are set in August, they may bear one light crop the next year and two heavier crops after that. When fields are set in the spring they usually bear two good crops. It is advisable to set a new patch every year or at least every two years. In lieu of this method, old strawberry beds are often renovated to save expense.

Methods of Renovating.—A good plan under the matted-row system is to plow a furrow through the middle of each row just after picking is over. The furrow slice is thrown on one side and kills that side of the mat. The other edge of the mat is left for the permanent row of plants. Cultivation follows in such a way as to level the soil back in place and thoroughly to destroy all weeds and strawberry plants between the rows. Thin out surplus plants in the row with a hoe. Either well-rotted manure or commercial fertilizer should be used at this time and cultivated in.

Why Renovate?—Growers consider renovation a satisfactory method of continuing a strawberry plantation. The renovated rows may bear several crops of berries, and the cost of renovation is very little compared to the cost of setting a new field.

Objections to Renovating.—If fields are infested with insects and diseases, renovation does not control these as well as planting a new field. The yields from a renovated field may be as heavy the first year after renovation as any other year. This is encouraging; but in the second and third years the yields will be rather light and the quality poor as compared with new fields. Weeds are apt to be much more troublesome in a reno-

vated field than in a newly set field. This is one of the greatest objections to renovation.

Job 11. Harvesting, Grading, and Packing

Conditions Usually Found.—(1) Commercial growers are usually careful and successful in harvesting, grading, and packing strawberries for market. (2) Beginners often fail to meet market requirements in these jobs.

Aims.—(1) Students should learn just when to pick strawberries for market and for home use. (2) They should learn to grade and pack properly for market.

Problems for Study and Discussion

1. What differences in ripeness are there between fruit to be used at home and fruit to be sent to market?
2. Describe the picking of strawberries and tell how they are packed for market.
3. Discuss pan grading of strawberries.
4. Describe how to make picking trays for holding several berry boxes.
5. Of what use is a packing shed for commercial growers?
6. Where should it be located?
7. Find the cost of basket and crates.

Activities.—(1) Compare results with adult and with young pickers. (2) Compare grading berries by pickers in the field with other methods of grading.

Picking Strawberries.—The home patch should be picked frequently and no berries should be allowed to rot on the vines. This practice would take away too much of the strength of the plants. Most varieties can be picked as soon as they show half color or a little more. Those to be shipped long distances need to be picked greener than those to be used at home or sold in a local market. The calyx and perhaps a portion of the stem should remain attached to the berries. This is the natural separation from the plant in most cases.

Never mass the berries in large vessels. They should be kept in light wooden berry boxes holding one quart (Fig. 123). In commercial picking, each picker is assigned to his own row and required to pick it clean as he goes. The berry boxes are carried in shallow trays with strong handles. These trays usually hold from 4 to 8 quart boxes. The grading and repacking are done at a central headquarters where they are loaded for market. Each picker is given a ticket in the form of a tag tied to his crate or to his clothing. It is punched by the foreman as each lot of berries is delivered. The pay varies from one cent to two cents a quart in different sections and different years.

The Packing Shed.—This may consist of a tarpaulin or paper roof, supported on poles. Shade and shelter are the important requisites. Berries should not stand in the hot sun while being packed or while waiting to be taken to market. They should not be allowed to be wet with rain after picking. Such a shelter is a protection to the pickers at time of emergency. Tables or shelves should be provided for the packers where the berry boxes are refaced and properly filled. In some cases the berries

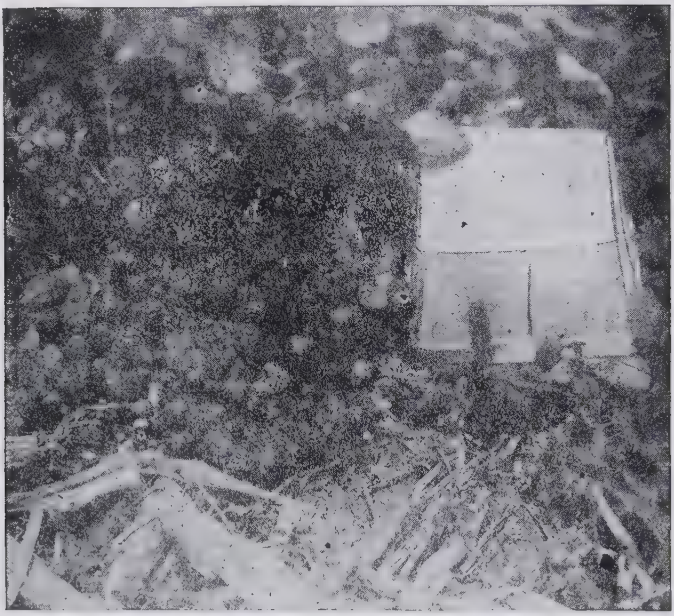


FIG. 123.—Corn stalks make a rather coarse mulch for strawberries, but will aid in keeping the berries clean. (New Jersey Station.)

are sorted according to size and quality at the packing shed. A triangular grading pan is used into which each box of berries is emptied. Poor fruit is removed and quality berries which remain are gently moved back into another box. Crates filled with mixed berries sell at lower prices than those which are uniform in size.

Adherence to standard strawberry grades is very desirable when packing berries for market. Standard grading not only helps in preparing the crop for market but also makes easier the work of the state and federal inspectors at the point of shipment or destination; it is an aid to buyers who purchase fruit in quantity and to the consumer who purchases by the box.

Job 12. Marketing and Using

Conditions Usually Found.—(1) Even experienced growers often make serious mistakes in marketing. (2) Coöperative marketing associations have usually proved themselves valuable to growers.

Aims.—(1) Students should learn to solve market problems to best advantage. (2) They should learn the advantages of coöperative marketing.

Problems for Study and Discussion

1. Find what prices have been received by growers of strawberries in recent years.
2. Find also what prices have been paid by consumers for strawberries.
3. Talk with growers who have had bad experiences in marketing.

4. Try to solve each of their difficulties.
5. What are the advantages of coöperative marketing?
6. What do local growers say about this?
7. How can growers avoid shipping to congested markets?
8. Ask growers whether they have profited by buying fertilizer, crates, and other supplies coöperatively.
9. If coöperative associations have failed, find the causes.
10. Have outsiders profited by prices maintained by a coöperative association? How?
11. Why is this unfair to the association members?
12. What extensive use is made of surplus fruit from commercial plantations?
13. Describe the making of fruit juices for soda fountains.

Activities.—(1) Try selling berries at a roadside stand, using suitable means of advertising the fruit. (2) Try making fruit crush and juices when berries are cheap.

Strawberry Prices.—This topic was discussed briefly in Job 1. Prices at farms in the United States have recently averaged through the picking season, including all states, $1.60 per crate. Some of the best growers, selling under careful marketing, have realized from fifty to a hundred per cent above this average.

Consumers buying single boxes at retail usually pay about twice as much per box as the producer receives.

Marketing Difficulties.—With fruit as perishable as strawberries, a number of difficulties are likely to confront the seller: (1) The fruit must be shipped and reach its destination very soon after picking. (2) The owner or a good manager must know where the product is to go and whether there will be consumers ready to buy it. (3) Congested markets must be avoided, as reshipping before the fruit spoils is usually out of the question. (4) Friendly commission men or large dealers must handle the fruit, as they may discriminate against any particular shipment on the slightest pretext. (5) Sundays and holidays may cause many losses at the shipping end or at the receiving end of the shipment. (6) Bad weather may interfere with the handling of the fruit at either end of the shipment. (7) As this crop is shipped in the early part of the fruit season, facilities for icing cars are not always favorable at every desirable point. (8) Diverting shipments to more favorable markets after the cars have started is more hazardous than with less perishable fruits.

These difficulties, and others which might be mentioned, clearly show the importance of having a good manager on the job when strawberries are being marketed. The producer may be extremely busy with the harvesting, grading, packing, and loading of fruit. He has little time to give to the intricate marketing problems. A good manager should give his entire attention and be diligent in looking after every detail of marketing. What the grower receives for his fruit depends as much upon successful marketing as upon successful growing, harvesting, grading, and packing.

The advantages of coöperative marketing have been enumerated in the apple marketing job. Among these should be remembered the buying of supplies such as containers, fertilizers, spray materials; the securing of capital at low rates with which members may harvest the crop; the providing of a supervisor for the standard grading and packing of fruit as well as a good manager for marketing the crop.

Outside Growers.—Strawberry growers who are not members of the fruit association do not aid in maintaining the association. In fact, their actions tend to destroy rather than support the association. They do, however, reap the benefit of prices maintained by the association. In any region where the association is paying its members good prices for berries, the outsiders get the same prices from outside buyers for the same grades of berries. Picture the attitude of these outsiders who are hanging on the edge of the enterprise reaping the rewards of a strong fruit association and not helping to support it.

Surplus Fruits.—At the height of the picking season prices may drop to a ruinous level. Growers are justly discouraged at such a time. An outlet for surplus fruit at fair prices should be provided. A small preserving plant at each large shipping point may meet this need.

Crushed Strawberries.—This product is made either at the shipping station or, sometimes, in the large market centers. Overripe fruit is best for this. Some of the Monday-morning pickings may be too ripe for shipment. Growers may at any time leave the crop in the field until it is ripe enough for this purpose. Girls are usually used in picking over the berries to remove calyxes and hard berries. After washing, the berries are spread in layers in clean wooden barrels with layers of sugar between the layers of fruit.

Other forms of preparing material to be used at soda fountains for strawberry sundæs, and of preparing juices and crushed fruit for use in making conserves, jams, and jellies should be considered by those having the task of taking care of the strawberry surplus.

Preservation of Strawberries by Freezing.—A comparatively new method of preserving strawberries by freezing is rapidly being perfected. Information on this subject is available from the experimental work in progress in the United States Department of Agriculture and several of the State Experiment Stations. A bibliography on "Freezing Preservation of Fruits and Vegetables" by J. A. Berry and H. C. Diehl of the Frozen Pack Laboratory, Seattle, Washington, containing several hundred titles, is now available.

Job 13. Keeping Records

(See record forms in apple enterprise.)

CHAPTER V

GRAPE ENTERPRISE

Analysis into Jobs.—The teaching units in this enterprise, including the operative and managerial jobs, are included under the following twelve heads. References are given to U. S. Farmers' Bulletins. See also *American Grape Growing*, Hedrick; *Productive Small Fruit Culture*, Sears; *Small-Fruit Culture*, Shoemaker; and the yearbooks of the U. S. Dept. of Agriculture, 1925 and 1937.

1. Determining possibilities with grapes.
2. Choosing the type and the varieties, 1454, 1689.
3. Propagating and buying plants, 157, 471.
4. Choosing the location and the field.
5. Preparing soil and providing plant nutrients.
6. Planting the vineyard.
7. Cultivating the vineyard.
8. Pruning and trellising grapes.
9. Controlling enemies, 1220.
10. Harvesting, grading, and packing, 1558.
11. Marketing and using, 900, 1075, 1144, 1471, 1551.
12. Keeping records, 511, 572, 782, 1182, 1551.

Job 1. Determining Possibilities with Grapes

Conditions Usually Found.—(1) Large commercial vineyards are usually restricted to special regions particularly favorable to grapes. (2) A few grapes are grown for home use in many home fruit gardens. (3) Yields are often lower than they should be.

Aims.—(1) The suitability of the region, the soil, and markets should be understood. (2) The labor and capital requirements should be considered. (3) The technical knowledge needed and the uses to be made of the crop must not be overlooked.

Problems for Study and Discussion

1. Find to what extent commercial grape growing is followed in your region
2. Count how many farmers and others grow grapes for home use.
3. What reasons are given by farmers for not growing grapes commercially?
4. To what extent would labor demands at harvest time affect this job?
5. How many years are required to bring grapes to bearing age?
6. What capital would be required to grow grapevines to bearing age?
7. What soils of your region would be well adapted to grapes?
8. Ask merchants and farmers regarding the prices and yields of grapes.

Projects.—Care and management of the vineyard for a year or two should be made a home or school project. It should include pruning, spraying, tying, cultivation, fertilizing, bagging of fruit, harvesting, putting up products, and marketing. Setting, trellising, and care of young vines may be a project for the first year of the vineyard.

Grape Regions.—The most intensive grape culture is in western New York and adjacent territory and in southern California. Many other smaller centers, however, are found. Most states have some commercial vineyards. Many regions might well be used for commercial growing of grapes which are not now used. The success of home vineyards is a good guide in deciding whether or not commercial vineyards would be sufficiently productive.

Soils.—The grape is not particularly partial to special soils, though it will thrive much better on the medium sandy loams than on the heavier soils. Almost any good garden soil will grow grapes successfully.

Outlet for the Crop.—Before undertaking this enterprise, the young grower should decide what uses or what markets are available. Good local markets may consume the product from small vineyards, but conditions should be favorable for marketing if large vineyards are undertaken. Local grape-juice plants are found in many regions. These will consume the surplus product when prices are rather low. Such factories do not buy grapes at high prices. Roadside markets offer an outlet.

Capital and Labor.—Grapevines come into bearing at about the third year after planting in the vineyard. Intercrops may be grown between the rows during these early years. These intercrops should surely pay for the cost of establishing the vineyard. The cost of purchased vines will average as much per acre as for orchard trees. Home propagation by cuttings is sure and rapid with many varieties.

The chief labor difficulties are likely to be encountered at harvest time. The harvest period may, however, be prolonged through several weeks if labor is scarce. Fewer hands may be used for a longer period of time than with berry crops or peach crops.

Technical Knowledge.—Successful grape growing requires considerable knowledge, but this is easily acquired. Enemies must be understood, but they can be positively and successfully controlled.

Job 2. Choosing the Type and the Varieties

Conditions Usually Found.—(1) The number of successful commercial varieties is rather limited and markets are very partial to certain varieties. (2) New types and varieties are not regularly salable.

Aims.—(1) The several types and varieties of grapes should be understood. (2) Their special adaptations to market and home use should be known.

Problems for Study and Discussion

1. Ask merchants and growers which varieties are most popular in your region.
2. Make a list of the best commercial varieties which you would grow.
3. What colors of grape are most desired in your markets?
4. What type of grape sells best?
5. What varieties are found in home vineyards which are not grown commercially?
6. Talk with growers as to what varieties seem to be most resistant to black rot and other diseases.

7. Why should not personal preferences as to color and flavor enter into the selection of commercial varieties?
8. What varieties are preferred for grape juice?

Activities.—(1) The varieties found in markets should be obtained and studied. (2) Compare the vigor, resistance to disease, abundance of fruit, and length of growth of vines of varieties in vineyards.

Types of Grapes.—There are three main types of grapes recognized. (1) *Vinifera* grapes of Southern Europe are probably the oldest for human use. These are grown in California most abundantly. There are many varieties of these which have skins adhering to the flesh. This causes the grape berry to be rather tough and to stand shipping well. They are used for raisins and dried "currants" as well as for table use and for wine. They are commonly found in all markets through a much longer season than other grapes, partly because they will stand storage.

(2) The so-called southern bunch grapes are suitable for growth through the southern states. Good varieties of this type are Headlight, Herbemont, Brilliant, and Bailey.

The great crops of muscadine grapes may be grown in states east of the Mississippi river and south of the Kentucky line. A trial nursery of muscadine grapes conducted by the United States Department of Agriculture in North Carolina has proved these varieties can withstand the winters in the warmer parts of that state. Probably the best muscadines named in order of ripening are Memory, Thomas, James, and Luola.

(3) Northern bunch grapes have slip skins which separate readily from the pulp of the ripe fruit. This type is most common in the northern, central, and eastern states, and is indeed grown abundantly throughout the United States and Canada.

Varieties of Northern Bunch Grapes. These grapes have been grown since colonial days and many varieties have been developed by crossing the native American grapes with European grapes and by careful selections.

These may be grouped into three classes according to their color: black, red, and white (green to yellow). In the following list these are arranged by seasons of ripening. The better varieties are starred.

Early Black.—Champion, *Fredonia, Moore Early.

Early Red.—*Delaware, Lutie, Wyoming Red.

Early White.—Diamond, Empire State, Ontario, *Portland, Winchell.

Medium Season Black.—Campbell, *Concord, Eumelan, Herbert, Ives, *Worden.

Medium Season Red.—*Agawam, *Brighton, Caco, Iona, Jefferson, Lindley, Salem.

Medium Season White.—Duchess, *Niagara.

Late Black.—Norton, *Sheridan, Wilder.

Late Red.—*Catawba, Goethe, Woodruff.
Late White.—Noah, Golden Muscat, Triumph.

New varieties, superior in one or more ways to the older, standard sorts, are being developed at several State Experiment Stations. Since certain varieties, both old and new, are especially adapted to certain regions and cannot be successfully grown in other sections, it is highly desirable that inquiries be made of your own Experiment Station to determine what varieties they recommend for your section.

Importance of Color.—Most markets prefer the blue or black grapes. This partially accounts for the popularity of Concords, which variety fulfills about nine-tenths of the market requirements for this type of grape. The next most popular color is white or green, of which the Niagara variety is the best and most popular example (Fig. 124). Red grapes stand third in popularity, and the Delaware variety is undoubtedly the most popular of this color. Some of the red varieties, however, keep especially well in storage at temperatures near 38° F.

Resistance to Disease.—Some varieties of grapes are very much less susceptible to black rot and other serious diseases than others. None of the best commercial varieties of northern bunch grapes, including Concord, Niagara, and Delaware, are especially susceptible to black rot. Some of the less common varieties are very seriously affected by the disease.

If a variety is otherwise desirable, choose a site with good air drainage, and aid disease control by well timed applications of Bordeaux.

Job 3. Propagating and Buying Plants

Conditions Usually Found.—(1) Most varieties of grapes are so easily propagated that many commercial growers and some small growers root their own cuttings. (2) Grapes are sometimes propagated by nurserymen under contract with growers, the cuttings being taken from bearing vines in the grower's vineyard. (3) Vines for vineyards are usually purchased from nurserymen, especially if new varieties are wanted.

Aims.—(1) Methods of propagating grapes should be understood and practised. (2) How to buy healthy, vigorous plants should be known.

Problems for Study and Discussion

1. Ask growers regarding methods which they have used for procuring grapevines.
2. What are the advantages in propagating your own vines?
3. Give the details of propagating grapes by cuttings.
4. When and how should the cuttings be made?
5. Tell how to store cuttings until planting them.
6. Describe the planting of cuttings.
7. What care should be given the nursery rows?
8. How would you judge good vines purchased from a nursery?
9. When would you place your order with a nursery for grapevines?
10. How should the shipment be handled when received?
11. What is meant by vine layering? When is it used?
12. What is saddle grafting?
13. When is this method used for grapes?

Activities.—(1) Practise making many grape cuttings, and labeling and storing them properly. (2) Conduct a nursery project including grapes of several kinds, for sale or for home use.

Advantages of Home Propagation.—Grapes are easily propagated by cuttings. Individual variation among the vines makes it important

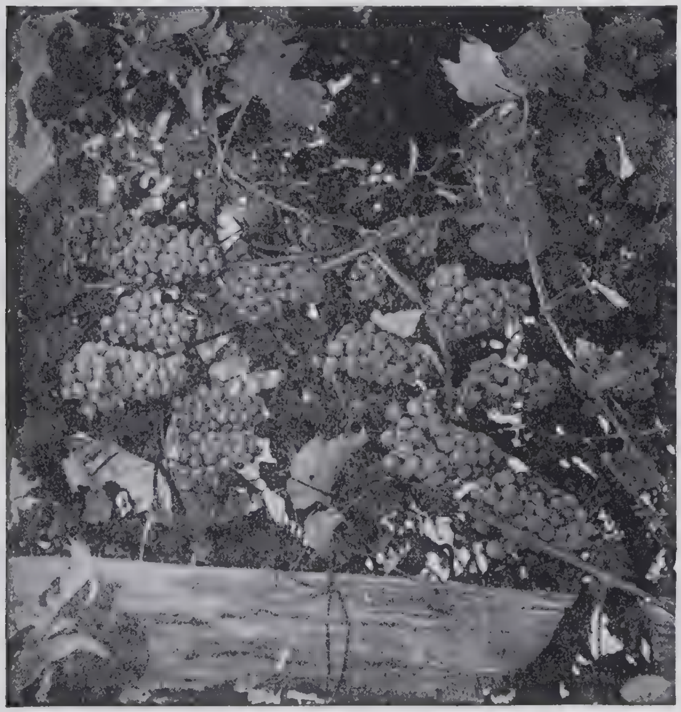


FIG. 124.—White Niagara is a favorite variety of dessert grape. Its quality is improved by allowing it to remain on the vine until it becomes yellow in color. (Rittenhouse School Gardens.)

that the grower select cuttings from productive vines. The grower can be certain of having the right variety. Diseases and other enemies from the outside will not be introduced. The cost is very low if a large number are propagated at one time.

Buying Vines.—Careful, reliable nurserymen can supply healthy and well-grown vines true to variety name. If possible, the order should be placed several months before shipment is expected. If many vines are to be purchased, a visit to the nursery will make it possible to see

that conditions have been favorable for the production of good vines and that careful methods are followed regarding diseases, insects, and labeling. Vigorous one-year-old vines are best.

Good vines should be free from knots or galls on the roots. They should have a good bunch of fibrous roots. They should show a good growth of vine and should bear no signs of black rot or other diseases.

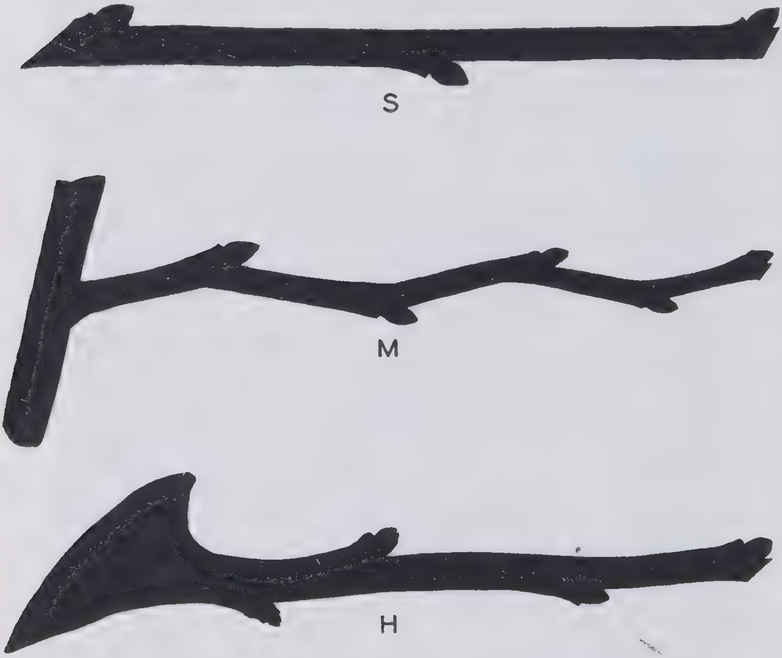


Fig. 125.—Forms of hardwood cuttings: S, simple; M, mallet; H, heel.

Heeling-In.—As soon as vines are received from a nursery, or dug from the nursery rows if propagated at home, they should be heeled-in to protect the roots. Exposure to sun and wind is very detrimental. (*See* Figs. 117 and 118, strawberry enterprise.)

Making Cuttings.—Ripe wood cuttings are made in the winter. If the climate is severe, this should be done before the coldest weather. Each cutting should bear about three buds or more. Each end is cut near a bud so as to leave a bud near the top and one near the bottom of the cutting (Fig. 125). Tie cuttings in bunches with wire. Label them with the variety name. Bury in damp sawdust in a cool cellar until planting time in late spring. During the storage period the ends callous and roots

may start from the lower end. Some prefer standing the bunches upright so that a little light may strike the upper end of the bunch. Unless the cuttings are held until rather warm weather, this method of exposure to the light is not important.

Planting Cuttings.—Set the cuttings in a deep furrow in a sloping position, leaving the top bud out of the soil. Tramp the soil firmly against the cuttings. They may be set at intervals of one to two feet in the row so that there is room for vine growth during the first season.

Care in the Nursery.—Clean cultivation should be given the rows of cuttings during the growing season. Weeds should be kept from about the young vines by hoeing if necessary. Supply manure or nitrogenous commercial fertilizers to stimulate the growth of vines the first year. These may be ready to set in the vineyard after one year's growth, but some grape growers prefer two-year-old plants for the vineyard.

Layering.—For grapes which root poorly from cuttings, or when a grower has a rare plant, vine layering is sometimes used. This simple method consists in laying canes down on the ground and covering them at suitable intervals to take root. After rooting, they may be cut apart and planted.

Grafting Grapes.—In the *Vinifera* types of grapes, propagation is commonly accomplished by grafting cuttings upon the roots of species resistant to phylloxera, a form of plant lice which attacks the roots of *Vinifera* grapes if they are not grafted on resistant stocks. The saddle-grafting method is one form of grafting grapes where stocks are growing in the soil. A V-shaped cut is made in the cutting or scion and a wedge cut at the crown of the stock. These are fitted, tied, and waxed. With the union below ground, soil is banked around the scion up to the top bud. Unproductive vines may be worked over by cleft grafting.

Job 4. Choosing the Location and the Field

Conditions Usually Found.—(1) Commercial vineyards are usually favorably located. (2) Vineyards for home use are often placed where they are handy, and no effort is made to favor the vines in the location.

Aims.—(1) Proper choice of a field and location for the vineyard should be understood by students.

Problems for Study and Discussion

1. Ask the best growers to describe favorable locations for vineyards.
2. What is the relation between the time of blossoming and the location of a vineyard?
3. Why are southern slopes more common for vineyards than for orchards?
4. In choosing a field, what dangers should be avoided?
5. What farm crops may be affected with nematodes?

6. Show the relationship between this knowledge and the location of a vineyard.
7. Ask growers how often grapes are killed by spring frosts.

Activities.—(1) Stake out a field for grapes. (2) If a suitable hillside be selected, run terraces around it for planting grape rows.

Location.—For small vineyards it is well to have the location near the house, where the fruit can be watched and protected from marauders, birds, and other enemies. Diseases and insects will be noticed more quickly. If the vines are to be trained on a shady arbor of permanent character, this should be located where it will be a convenience and a pleasure to the household.

If the crop is to be grown for market, a hillside is to be preferred. Good drainage of the soil is thus supplied, which is very essential to successful growth. Air drainage is an advantage also.

Exposure.—A southern or southeastern exposure is preferred for grapes. Very good air drainage and soil drainage are necessary. Blossoms are formed on the new growth of wood. This usually delays the blossom season until some of the danger of spring frost is over. But grapes are sometimes killed by late spring frosts. A northern slope tends to delay the crop more and may be the best exposure in some sections. Grapes want a warm soil, and a southern exposure will aid the growth.

Avoiding Nematodes.—In choosing the field for grapes, do not fail to detect the presence of nematodes on preceding crops, if this enemy has attacked them. Among the crops which may foster nematodes in the soil are strawberries, raspberries, blackberries, root crops, and several varieties of soybeans. Grapes are susceptible to this trouble and as the vineyard is to remain many years it should be started on soil which is believed to be uninfested.

Job 5. Preparing Soil and Providing Plant Nutrients

Conditions Usually Found.—(1) Commercial vineyards seldom suffer from poor preparation of soil or improper setting of the plants. (2) Small vineyards are often not well nourished.

Aims.—The proper preparation of soil and the supplying of plant nutrients should be understood.

Problems for Study and Discussion

1. What types of soil found in your region are best suited to the growing of grapes?
2. How do grape growers prepare such soil before planting?
3. What plant foods do they consider important for the best growth of crops on this type of soil?
4. Get their opinions regarding the use of green manure and barnyard manure on the soil before planting grapes.
5. What green-manure crops would you grow in your region for this purpose?
6. Describe the best method of supplying organic matter for your location.
7. Give directions for thorough preparation of the soil.

Activities.—Contrast two methods of preparing soil, and two different rates or methods of fertilizing or manuring it.

Improving Light Soils.—Organic matter is supplied by applications of barnyard manure or by turning under a green-manure crop, preferably a legume. Such a plan will provide the nitrogen in the soil which is necessary for the growth of vines during the first few years.

Heavy Soils.—If soils have much clay or if the subsoil is very heavy, organic matter will improve the physical texture. A better soil condition for the roots will be provided and growth will be more vigorous, with more profitable crops.

Preparing the Soil.—Vineyards on hillsides may wash badly. For this reason, delay plowing until spring. A cover crop should protect the soil during winter. Some very steep hillsides are never plowed all over, but each row or terrace is plowed with about four furrows, along which the vines are planted. After plowing, the soil should be well disked and then harrowed to put the surface in good condition for planting.

Job 6. Planting the Vineyard

Conditions Usually Found.—(1) Experienced growers have very little difficulty in setting grape vines well. (2) Beginners make mistakes which result in inferior growth of the vines the first year.

Aims.—The best and most economical methods of planting grape vines rapidly and successfully should be understood by students.

Problems for Study and Discussion

1. At what season of the year and in what kind of weather should the vines be planted?
2. Talk with growers and determine how plants should be handled to prevent drying out while planting.
3. At what distances should vines be spaced in the vineyard?
4. How would you manage the distances when running the rows in terraces around a hill?
5. Calculate the number of vines required to set an acre of vineyard.
6. How should holes be made?
7. Give directions for setting a vine.
8. Discuss watering of plants at setting time for your region.

Activities.—(1) Practise setting vines by the best methods. (2) Vary the distances for setting according to vigor of the variety and to suit different methods of trellising.

Season and Weather.—A wide range of season and weather conditions will suit grape planting. Either fall or spring planting will probably be satisfactory. If the weather is extremely dry, plants should be watered at setting time. Choose a weather and soil condition which will provide moisture for the plants at first, particularly for spring planting.

Distance.—For most of the northern and southern bunch grapes, planting in rows eight to ten feet apart is common. The vines are usually spaced 8 to 10 feet apart in the rows. The number of vines for an acre of vineyard ranges from 435 to 680 vines per acre.

When vines are planted on terraced hillsides, they may be placed a little closer than in the block system. The rows may be made level, or

nearly so, around the hill. This allows for the making of a terrace for each row or for every few rows, and the vines are on the edges of the terraces.

Handling the Plants.—The roots of vines may be dipped in water or thin mud when taken from the heeling-in place to move to the vineyard. This protects the root hairs on the fibrous roots, and growth will start quickly. If tubs containing muddy water are used, the roots can be immersed while being moved on a stoneboat to the vineyard.

Making Holes and Setting.—It is a good plan to throw out two furrows along the line of each row, whether they be on terraces or in regular block planting. At the proper distances along each row holes are quickly made with shovels. Only a few shovels of dirt need to be moved, as the holes usually do not need to be very deep.

When setting, the lines should be made very true as they must fit exactly under the trellis to be erected later. One vine may be placed in each hole by an attendant working ahead of the setter. The latter should place the vines in exact position, cover the roots well with soil, and tramp it smooth. A plan followed by some grape growers is not to complete the filling of the holes until a little later. This allows the setter to keep up with the attendant who is distributing the vines. The setting work may thus be done very rapidly. If the soil is very heavy, less tramping is necessary. If it is in a rather dry condition, water may be applied soon after the setting.

Job 7. Cultivating the Vineyard

Conditions Usually Found.—(1) Commercial vineyards are usually better cared for than others. (2) Home vineyards are often not cultivated at all.

Aims.—The best methods of cultivating and managing the vineyard during the growing season should be understood.

Problems for Study and Discussion

1. Outline the annual plan of cultivating a vineyard recommended by the best grape growers.
2. What intercrops are grown in vineyards in your region?
3. Suggest better crops for growing in vineyards than some of those grown locally.
4. For how many years should an intercrop be grown in a young vineyard? Why?
5. What implements would you recommend for vineyards planted with distances of eight and of ten feet between rows?
6. Discuss clean cultivation vs. sod for vineyards on hillsides.
7. Compare results in two vineyards handled by these different methods.
8. How long would you continue cultivation between rows if you grew a winter crop each winter?
9. When should a winter cover crop be turned under?
10. If trellises are built, how often should the canes be tied to them during the summer?

Activities.—(1) Plant different intercrops between rows of vines and compare the results. (2) Continue two different systems of cultivating in a vineyard.

Annual Cultivation—Grapes respond well to clean cultivation of the soil. Grass or sod of any kind should not become established in vine-

yards if this can be avoided. After the vineyard is set, begin clean cultivation between the rows with a disk harrow of a width to suit the distances between the rows. This should be continued until midsummer, or a little later if an intercrop is not grown. A cover crop may then be sown for the winter, to be plowed under rather early the next spring.

Intercrops.—Some suitable intercrop, as discussed in the peach enterprise, may well be grown in the vineyard during the first two or three years. This should not be kept up after the fourth year at the latest. One

Fig. 126.—Winter vetch may form a good cover crop for a young vineyard. Rye is usually sown with the vetch in early fall. The growth is turned under or disked into the soil in spring as green manure.

row of beans or early potatoes may be grown between each two rows of grapes.

Cover Crops.—For vineyards on hillsides, as well as others, a winter cover crop should be grown between the rows. In warmer regions this may consist of crimson clover sown in the middles only (Fig. 126). Avoid throwing seed in the rows, as it may require hand work during the summer to clean out the rows. In colder climates oats and summer vetch are good, and the dead growth will serve as some winter protection and hold snows. The cover crop will prevent erosion and leaching in winter and provide green manure. The cover crop should be started by midsummer or soon

after and should be worked under each spring when growth is ready to start. On terraced hillsides cultivation between the rows should be kept rather level and the terraces should not be built up too high against the vines, as extra deep ridging of the vines tends to injure them.

Tying Canes.—After trellises are erected, the canes should be tied to them each spring so as to keep the long shoots in place and keep the vines and bunches of fruit in position. (See next job.)

Fertilizing.—The grape vine will not need heavy applications of fertilizer except on very light soils. The first year the vines are set they should have liberal applications of barnyard manure.

If commercial fertilizer is used it should contain nitrogen and possibly phosphate and potash. Use 200 pounds sulfate of ammonia or 300 of nitrate of soda per acre. Three hundred pounds of superphosphate and 75 pounds of muriate of potash may be added.

Job 8. Pruning and Trellising Grapes

Conditions Usually Found.—(1) Home vineyards are often not properly pruned; in many cases they are badly neglected. (2) Commercial vineyards are usually well pruned and trellised.

Aims.—Most suitable methods of cultivating, trellising, and tying grapes in each type of vineyard should be understood by students.

Problems for Study and Discussion

1. Ask growers of home vineyards what annual pruning is done.
2. Get reasons from them for and against pruning a home vineyard.
3. Compare examples of good pruning with others of little or no pruning.
4. What is the natural method of bearing grapes which allows the grower to prune away much of the old growth of canes? Explain.
5. Give directions for pruning grapes to be trellised according to the high-renewal system.
6. Give directions for pruning grapes to be trellised according to one of the Kniffin systems.
7. When should pruning of grapes take place? When should the canes be tied?
8. What is the Munson system of trellising?
9. What climatic conditions does it best suit?
10. Give directions for erecting a grape trellis for the Kniffin system or the high-renewal system.

Activities.—(1) Make trials to compare results of close pruning with those of slight pruning. (2) Conduct trellising experiments to contract two or more approved methods and determine which is best for your conditions. (3) Renew an old neglected grape vine.

When and Why Prune.—Grapes should be pruned every winter (Fig. 127). Never prune in the early growing season, as the canes are likely to bleed seriously. Light clipping of long shoots may be done in midsummer when desired. The heavy pruning should take place in the dormant season. Cut away the last season's growth of canes in proportion to the vigor of the vine and the amount of fruit produced the previous year.

The effect of not pruning the vines each year is gradually to divide the

strength of the plant so that the new growth in any one part is very limited and the possibility of fruit is thereby reduced. It is therefore difficult to allow vines to remain unpruned for the sake of having an arbor well covered without sacrificing fruit production. The best quality and yield are produced on well-pruned vines. Arbors cannot be continuously covered with vines in close pruning systems.

Fruit Bearing.—Grapes are borne on shoots produced just before the blossoms are formed. New shoots start from buds on the old canes, most of which should bear several clusters of blossoms and grapes. If too many buds on last year's growth are kept, the vine is unable to supply all with enough nourishment to produce a satisfactory crop. Better fruit and better results are obtained when the annual pruning is systematic and thorough. On home trellises grapes are often neglected, as the owner wishes shade rather than fruit. This plan has its good points, but the owner should not expect both shade and fruit in abundance.

Fig. 127.—Pruning shears. The handiest and most useful implement for the grower of grapes.

Fig. 128.—The upright or high-renewal system of pruning and training grape vines, after pruning. The fruiting shoots from these canes are trained upright and tied to the upper wires, as shown in next figure.

Trellising.—A number of plans for trellising are in use. Several of these have been given definite names. The high-renewal system is shown in figures 128 and 129. The six-cane Kniffin system is shown in figures 132 and 133. The Munson system is shown in figure 134. The grapes of the Pacific coast may be trained according to other systems suited to the species and to dry climates.

The trellis for a bearing vineyard should be built by the time the grapes are running enough to be damaged if not supported. This is usually about

the second or third year after setting the vines. Use durable posts of a height to suit the type of trellis desired (Fig. 135). These should be placed at suitable distances. In some plans there is one post between each two vines. The wires are stretched very tight and should be heavy enough and tight enough not to sag between posts. The end posts must be braced well. The trellises should be examined and repaired at least once a year to keep them in good condition.

Pruning.—Grapes should be pruned annually. The best time is in the winter when the sap is entirely dormant. If pruning is delayed until spring, the sap will flow from the wounds. However, it is better to prune late than not at all.

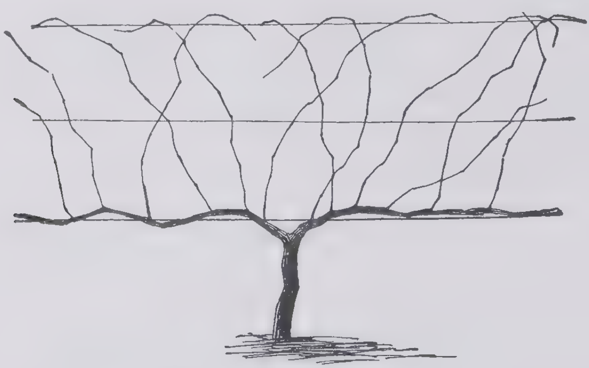


Fig. 129.—The high-renewal system of training the new fruiting shoots of grape vines. See the preceding figure. The wires are stretched at 24, 40 and 56 inches from the ground.

The system of pruning and the system of trellising should harmonize with each other. Make the pruning rather close each year. Remember that the crop is borne on the new growth and not on the old at all. There is very little need of saving much of the old wood except to form a trunk and enough of the last year's growth to furnish the buds necessary for the main shoots of the next season (Figs. 130 to 133). An examination of the accompanying figures will give a clear idea of the great amount of wood that can be cut away each year. For example, if five or six buds are left to form as many more shoots, there will be as much new wood as the root system can support and bear a crop of fruit.

Kniffin System.—This system is the most popular in Michigan and in the northeastern grape growing regions of the United States (Fig. 133). A one-year cane is left on each side of an upright for each wire, as shown. Usually the lower horizontal canes are shorter than those on the top wire. The length may vary, the weak canes being cut shorter than strong ones.

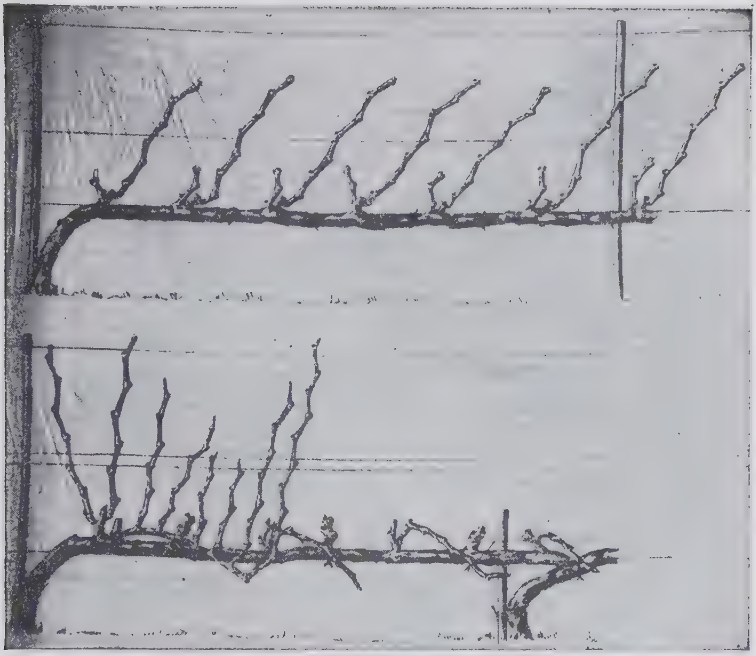


FIG. 130.—Grape vine pruned to single horizontal cordon. Spurs and half-long canes are left to form new growth.

FIG. 131.—New growth on grape vine pruned to single horizontal cordon. Compare with figure 130.

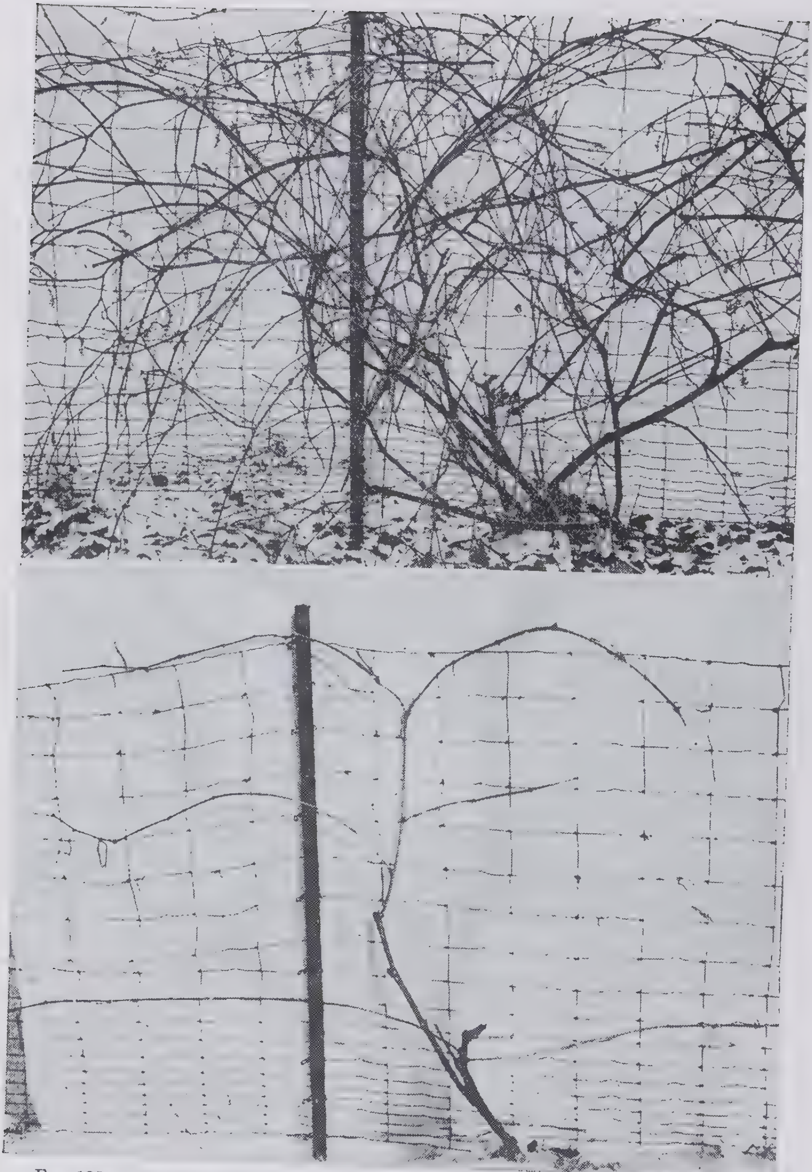


Fig. 135a.—Neglected vine before and after pruning. This vine had enough one-year-old canes so that it could be trained to a six-cane Kniffin system. It is not often possible to renew a vine completely in this manner in a single year. The dead wood, weak canes, and superfluous trunks were cut out. (Illinois Station.)

Problems for Study and Discussion

1. Find from local growers what vineyards have been attacked by black rot; by other diseases.
2. Find what insects are serious in your region.
3. What diseases and insects are considered serious in other regions?
4. Describe the attacks of black rot of grapes and tell how to prevent this disease.
5. Describe the attacks of powdery mildew and downy mildew and give directions for their control.
6. What is anthracnose disease? How is it controlled?
7. Describe the grape leaf-hopper and its work and give remedy.
8. Give the life history of the leaf-folder.
9. What damage is done by the grapevine flea beetle? How is it controlled?
10. Describe the effects of rose chafers and tell how to fight them.

FIG. 136.—Black rot disease is easily identified from this figure.

11. What grapes are attacked by phylloxera? How can this be prevented?
12. How can you control grapevine root worms?

Activities.—(1) Follow the spray schedule given in this job and study the effects. (2) When some leaf-eating insects are to be controlled, try both dusting and spraying on different vines and compare results.

Black Rot.—This disease is doubtless the worst enemy of the grape. There are very few grape-growing regions where it is not a serious trouble. The disease attacks the young shoots, tendrils, leaves, and fruit. It is most noticeable upon the fruit (Fig. 136). Crops are greatly reduced by the disease. Clusters are thinned and the berries shrivel and drop. Mummied fruits hold many spores over winter and the spores lodge in

crevices of the bark and buds. Warm, rainy weather multiplies the spores rapidly in spring and they attack new tissues not protected by spray material. Minute black spots are formed which spread rapidly and cover the whole surface of leaves, twigs, and fruit.

FIG. 137.—Gasoline engine sprayer with three nozzles on each side arranged for spraying grapes supported on three-wire trellises. Side view shown above. (Geneva, N. Y., Station.)

Remedies.—Spraying is very effectual against this disease if it is applied in time before the spores find lodgment in new tissues. Use Bordeaux mixture as for apple diseases. Applications should be made (1) in the spring when the buds are swelling; (2) just before the blossoms open; (3) just after blossoming is over. A fourth and a fifth application may be made to keep the new growth protected, at intervals of about two

weeks. The last two sprayings are not commonly applied unless the disease has been very severe (Fig. 137).

Burning of prunings, plowing under any spores in materials upon the surface of the soil, clean cultivation, and cutting away of basal suckers or shoots, are all good preventive measures.

Fig. 138.—Downy mildew disease causes green fruit to become hard and dry; the riper fruits shrivel and turn brownish in color. (Minnesota Station.)

Downy Mildew.—Green tissues of the plant are attacked by this disease. Leaves turn yellowish or brown. Vines are often nearly ruined and yields are greatly reduced. A grayish coating often appears when the fruit is attacked. The disease is readily recognized by the downy appearance on the under surfaces of leaves and on twigs and fruit (Fig. 138).

Spraying to prevent black rot should also prevent downy mildew. The clean-up methods recommended for black rot apply equally well here.

Powdery Mildew.—The two mildew diseases of grapes are somewhat similar, but powdery mildew attacks both surfaces of the leaves and seems to work more on the surface. The disease is more generalized over the whole vine, leaves and fruit. It gives an appearance of a white powder dusted over the plant. At first the leaves present a mottled appearance, but later the whole leaf is affected and dwarfed. A moldy odor may be noticed in the advanced stages. If blossom clusters are attacked, fruit fails to form, or young berries may drop from the clusters.

Prevention.—Moist weather is favorable for the growth of this disease. Vines planted with plenty of room or well opened on trellises or closely pruned are less likely to be affected, as more sun and ventilation are provided. The clean-up methods and the spraying campaign recommended for black rot should be followed for powdery mildew. Some growers dust the plants with sulfur if attacks occur at blossoming time. This should be used as a preventive rather than as a cure.

Anthracnose.—Because of the nature of the attack, this disease is called *bird's eye rot.* It attacks young canes and is very conspicuous on leaves and fruit. Deep sunken areas or cankers and grayish or dark discolorations on the under surfaces of canes give a burned appearance. Brown spots with whitish centers are often seen on the fruit. Cracking of the berries may follow. Dried, mummified fruits sometimes appear, as in the case of black rot.

Clean-up and spraying campaigns recommended for other diseases are effectual against anthracnose.

Grape Leaf-Hoppers.—These minute sucking insects are yellowish white in color. They hop and fly quickly when approached and are therefore difficult to control. They hide beneath the leaves, sucking sap and weakening the plant. Leaves turn brown and may fall.

Control.—As the adults live over winter in rubbish and crevices about the vines, close pruning and clean-up methods are advisable. This insect, like all other sucking insects, should be sprayed with nicotine sulfate. In early summer, when the young leaf-hoppers are beginning to hatch, spray thoroughly with nicotine sulfate, 1 part to 600 parts of water. This may be mixed with other spray materials in fighting chewing insects and diseases. If two operators work at the same time, one on one side of the row and one on the other, the insects cannot escape so readily.

Grape Leaf-Folders.—This enemy occurs throughout the United States. Its damage is of less importance than some other grape insects. The larva folds the leaf over and fastens it with a web. It feeds upon the leaves and other green tissues.

Control.—If the attacks are not serious, the larvæ may be crushed by hand or the leaves picked off and burned. In bad attacks spraying

with poison, as arsenate of lead, is recommended. Do this while spraying with a fungicide against diseases.

Grapevine Flea-Beetle.—The buds of the vines are attacked in early spring by flea-beetles. If poison is used with the fungicide when fighting black rot very early in the spring, this enemy may be readily controlled. It is somewhat more difficult to poison than most insects and the strength of the poison may be doubled.

Grape Berry Moth.—Eggs laid on or near the blossoms hatch and the larvæ attack the blossoms and buds and make webs among the blossoms. A second and a third brood come later in the season, overlapping somewhat. These attack the fruits, living on the pulp and seeds. They spoil many clusters and cause rot to attack the fruit.

Control.—The regular spraying schedule should control these insects if applied at the right time. It is found advisable to mix a sticker with the poison material. This may consist of resin fish-oil soap in the spray applied just before the grapes touch in the cluster. Successful poisoning of the early brood saves trouble later.

Climbing Cutworms.—There are several species of cutworm which climb trees, grapevines, and other plants to eat tender parts. Several of these attack young fruit buds of grapevines in spring, doing their feeding at night.

Control.—It is difficult to poison these cutworms. They are less serious when some cover crop is growing on the soil, as they seem to prefer such crops when green. They are much more serious in sections having light soils. Cotton-batting collars and bands of tanglefoot used on the trunks of vines will prevent the climbing.

Rose Chafers.—Grapevines are often seriously attacked by these beetles, which eat the surfaces from the leaves. When they are very abundant the most successful and practical method of control is to use excess arsenate in the regular spray schedule for black rot and add a gallon of cheap molasses to each 100 gallons of material to induce beetles to eat the poison more freely.

Grape Root Worm.—The adult beetles are small, grayish-brown insects. When they appear in spring they begin feeding on the leaves, sometimes nearly defoliating the vines. In mild cases only holes in the leaves are noticed. Eggs are soon laid under the loose bark of the vines. The young larvæ drop to the ground when hatched and work into the roots. From this habit the name is derived. The root system is sometimes nearly destroyed, causing the dropping of fruit and leaves. A weakened appearance is certain to be noticed and the vineyard is greatly impaired.

Control.—Poisoning, as for other leaf-eating insects, is the best method

of fighting these beetles. Use one to two pounds of arsenate of lead in fifty gallons of water or mix the poison with Bordeaux sprays when fighting other enemies. Clean cultivation early in the spring may destroy many of the wintering places of the larvæ.

Phylloxera.—These tiny plant lice are common on varieties grown in California and other dry regions. The *Vinifera* grapes are especially susceptible except when they are grafted upon resistant stocks. Native grapes are not seriously injured.

Suggested Spray Program for Grapes

When	What to Use	What For
Dormant season	Lime sulfur 6 gal.-50 gal.	Scale insects and anthracnose
As buds swell	Lead arsenate 2 lb.-50 gal.	Flea beetle and black rot
Before bloom	Bordeaux 4-4-50 with lead arsenate 1½ lb.-50 gal.	Anthracnose, black rot, berry moth, rose chafer, leaf folder
When blossoms fall	Same	Same; also root worm and mildew
Ten days after fall of blooms	Bordeaux with 1 lb. calcium arsenate-50 gal.	Same

Note.—See special directions for leaf hopper control. Also consult your local Experiment Station.

Job 10. Harvesting, Grading, and Packing

Conditions Usually Found.—(1) Grapes are usually carefully harvested, graded, and packed by commercial growers. (2) Some mistakes are made by beginners.

Aims.—The best and most economical methods of harvesting, grading, and packing should be understood by students.

Problems for Study and Discussion

1. How do growers judge the ripeness for market of early varieties?
2. What differences in picking time would you make for grapes intended for home use?
3. Give directions for carefully picking grapes without injury.
4. Debate picking on trays or in large baskets to be sorted and repacked vs. picking in market containers.
5. Why would you want a packing shed in a commercial vineyard? Where located?
6. What containers should be purchased for marketing the grape crop?
7. Why are grapes heaped in the basket and allowed to wilt before covering?

Activities.—(1) Trials should be made to test the value of grading in the field vs. grading and packing at a packing shed. (2) Test the value of letting grapes settle for several hours before covering the baskets.

Judging Ripeness.—Grapes color some days before they are really ripe. For shipment, picking may occur in the early coloring stage; but

for home use or for sale in local markets the fruit should remain on the vines longer. The grapes will improve in flavor, aroma, and appearance.

Careful Picking.—Bunches of grapes should be handled by the main stem. They may be removed from the canes by the fingers or picking scissors may be used. The berries should be touched as little as possible by the hands. For the bunch grapes with slip skins, it is best to handle the bunches as little as possible.

FIG. 139.—Picking and packing grapes in the vineyard (Cornell Memoir 28).

Picking into Market Containers.—Many commercial growers consider it a good plan to pick the crop directly into the market baskets. This avoids a second handling. This plan requires that each picker shall know how to pack baskets properly (Fig. 139).

Packing Baskets.—For small baskets the bunches are placed at an angle so that the weight of each bunch is against the next bunch or against the side of the basket. Baskets should be made to heap a little at first. The covers for the baskets are not put in place until the next day (Fig. 140). This allows the stems in each bunch of grapes to collapse

or wither a little, and the berries lie closer together. If this precaution is not taken, the baskets will reach the market in a loose condition.

Containers.—Climax baskets with temporary or permanent handles over the center are commonly used for grapes. There are several sizes of these used, 2-, 4-, and 12-quart. The small sizes are used in the early part of the season. Georgia peach carriers are also used for grapes. These contain six gallon baskets.

A Packing Shed.—This is a place where grapes may be repacked or where the baskets may be assembled during the wilting stage. Containers may be stored temporarily in the shed. It should be located in a central position or near the road where the trucks or wagons must be loaded.

Job 11. Marketing and Using

Conditions Usually Found.—(1) Commercial grape growers usually market their crops successfully. (2) Unsatisfactory results may occur. (3) Special uses of surplus grapes are more common than formerly.

Aims.—(1) The best methods of marketing grapes should be understood. (2) Suitable outlets for surplus fruit should be learned.

Problems for Study and Discussion

1. What has been the range of prices for grapes sold during the last few years?
2. How do these compare with prices paid by consumers for grapes?
3. Talk with managers or with grape growers who have been successful in marketing to learn their methods.
4. What difficulties have they had which could be prevented?
5. How do they avoid shipping to congested markets?
6. How much have they spent in a season for telegrams and telephones in locating favorable markets?
7. Get opinions of growers regarding coöperative associations.
8. Ask particularly regarding the savings by buying supplies through such an association.
9. Review advantages of coöperative marketing in the stone-fruit and apple enterprises.
10. Locate the nearest grape-juice plant for your region.
11. What other use is made of surplus fruit besides making grape juice?

Activities.—(1) Compare two or more methods of selling grapes. (2) Try making unfermented grape juice for use in winter. (3) When grapes are low in price make up a lot into grape juice and sell the product. Compare the returns of the two methods.

Coöperative Marketing.—Among the elements for successful marketing of grapes may be mentioned the following: (1) arranging for outlets and controlling sales in advance of harvesting; (2) being able to guarantee a uniformly packed product; (3) having a large enough supply individually or through coöperation with others, to satisfy large buyers; (4) having cars engaged and ready for shipments; (5) knowing the market situation in the different market centers; (6) moving fruit promptly and rapidly in properly iced or refrigerated cars; (7) using express shipments

when carload lots cannot be produced; (8) shipping a steady supply to satisfy regular buyers; (9) diverting shipments when congestion is discovered ahead; (10) telegraphing and telephoning constantly to always avoid congested markets; (11) attending to business details punctually

Defects in Marketing.—Each of the eleven factors for successful marketing mentioned under the preceding topic presents difficulties which every manager or grape grower can detect. A good manager will attempt to avoid all these difficulties by foreseeing them and avoiding them.

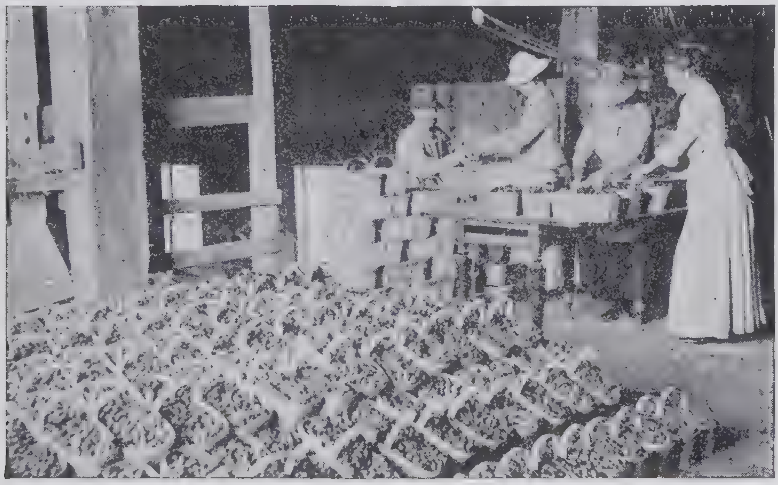


FIG. 140.—Putting covers on grape baskets in preparation for hauling to shipping station. (Cornell Memoir 28.)

Avoiding Congestion.—As already stated, markets must be studied carefully and constantly. Keeping a close account of the situation in each market is necessary for success. Much telegraphing and telephoning may be necessary. A good agent in each market center should be located and his confidence established. If possible some of these should be brought to your shipping point and to the local vineyards, so they will understand the situation. Ask them to warn you by telegram when markets are becoming crowded. They may know how many cars are enroute to their markets at any time. They can aid shippers in diverting cars and predicting slumps in their markets. Confidential agents may be relatives, commission men known personally, jobbers, local dealers who keep close watch on markets, or local growers who understand market conditions well.

Coöperative Buying and Selling.—These topics have been analyzed and discussed in the apple and stone-fruit enterprises.

Grape Juice.—This product has enormously increased in demand in recent years. Grapes are taken for this purpose at prices much higher than formerly. Dark colored grapes are usually preferred for this product. Local factories are found in many places, but shipments may be made to grape-juice factories when necessary.

For small vineyards the making of grape juice on a small scale may be undertaken with profit. The product should be standardized; perhaps different varieties may be blended to advantage. If this meets the grades of the usual commercial product it can be sold with profit.

Jellies and marmalades are manufactured from surplus supplies of grapes. These find a ready sale when the product is standardized.

Note.—Considerable fundamental research in grape culture has been carried on by Federal and State Experiment Stations. By referring to the literature, a comprehensive bibliography of value on the subject can be built up.

Job. 12 Keeping Records

(See forms in apple enterprise.)

CHAPTER VI

BUSH-FRUIT ENTERPRISES

Analysis into Jobs.—The different operative and managerial jobs suitable for the separate teaching units and for analyzing the operations on a bush-fruit plantation are given under the following heads. The bush fruits included in this group are blackberries, raspberries, gooseberries, and currants. References are to U. S. Farmers' Bulletins. See also *Bush Fruits*, Card; *Productive Small Fruit Culture*, Sears; *Small-Fruit Culture*, Shoemaker; and the yearbooks of the U. S. Department of Agriculture, 1925 and 1937.

1. Determining possibilities with one or more of the bush fruits.
2. Choosing the kind and variety to grow, 887, 998, 1398, 1399, 1403.
3. Propagating and buying the bush fruits, 157, 1398, 1399.
4. Choosing the location and preparing soil.
5. Planting and cultivating, 1398, 1399.
6. Pruning and training the bushes, 1398, 1399.
7. Controlling enemies, 1286, 1398, 1399, 1488.
8. Harvesting, grading, and packing.
9. Marketing and using, 984, 1144, 1471, 1551.
10. Keeping records, 511, 572, 782, 1182.

Job 1. Determining Possibilities with One or More of the Bush Fruits

Conditions Usually Found.—(1) Commercial plantations of the bush fruits are usually considered very profitable. (2) Many grow these fruits for home use and sell the surplus in nearby markets.

Aims.—The several factors involved in determining the possibilities with bush fruits should be well understood by beginners.

Problems for Study and Discussion

1. Get opinions of growers, merchants, and others regarding the feasibility of growing each of these bush fruits.
2. To what extent are any of these fruits grown commercially in your region?
3. What objections are offered to the growing of such fruits?
4. What types of soil are best for blackberries and raspberries? For currants and gooseberries?
5. What are the leading regions for the commercial growing of these fruits?
6. How large a plantation would suit your region for home use and local sale?
7. What yields could be expected per acre from each of these types of fruit?
8. What prices have been received by those who sold these fruits in markets?
9. Estimate the cost of labor per year for an acre of one of these fruits. Get growers to assist in this if possible.
10. Compare the capital requirements for these fruits with the requirements for strawberries.
11. Inquire of growers regarding the duration of plantations.

Projects.—Students may well undertake projects with the kinds of bush fruits which are best known locally, provided good markets are within reasonable distance. Use the best methods, and good returns may be expected. If a patch is already growing on the home farm, it may be taken into the project and an additional area also started.

Regions.—Blackberries, dewberries, raspberries, currants, and gooseberries are abundantly grown near large market centers throughout the northern and central latitudes of the eastern half of the United States. The most intensive centers are near Lake Ontario in western New York, along the eastern shore of Lake Michigan, along the Ohio River near Cincinnati and Louisville, and along the Mississippi and Missouri rivers near St. Louis and Kansas City. Various western centers are shown on the maps on p. 209 (Figs. 141 and 141a).

Soils.—Most of the bush fruits may be grown on a variety of soils, provided the soils are moderately fertile, easily worked, and well drained though retentive of necessary moisture. The best soil for brambles is a deep, medium sandy to silt loam, well supplied with humus. Currants and gooseberries can endure very heavy soils, and as they want cool conditions for growth and considerable moisture in the soil, the heavy soils are probably best. The roots are shallow, and some mulching of the soil is advisable for protection during the winter and to prevent drying out of the roots in summer.

Yields and Prices.—The average yields of blackberries and dewberries for the whole United States are about 60 to 75 crates per acre; raspberries yield two-thirds as much. Good yields on plantations managed by good growers more than double these averages.

The average prices at farms in the United States have been about $1.50 to $2.00 per crate, but the range has been from fully twice or three times this in the early part of the season to almost nothing. When uses are provided for the surplus crop, low market prices may be avoided.

Labor and Capital.—Somewhat less labor is required for each of these bush fruits than for strawberries. The picking is perhaps more laborious for each crate of fruit but the yields are much less than for strawberries. The work of setting is less, as a smaller number of plants is required per acre.

The investment for a bush-fruit plantation is considerably lower than for strawberries. This is evident when we remember that a bush-fruit plantation may last for many years, while a strawberry plantation must be replanted about every third season.

Job 2. Choosing the Kind and Variety to Grow

Conditions Usually Found.—(1) Certain bush fruits are popular in some localities, while others are seldom grown. (2) Some varieties are much better suited to certain soils and regions than others.

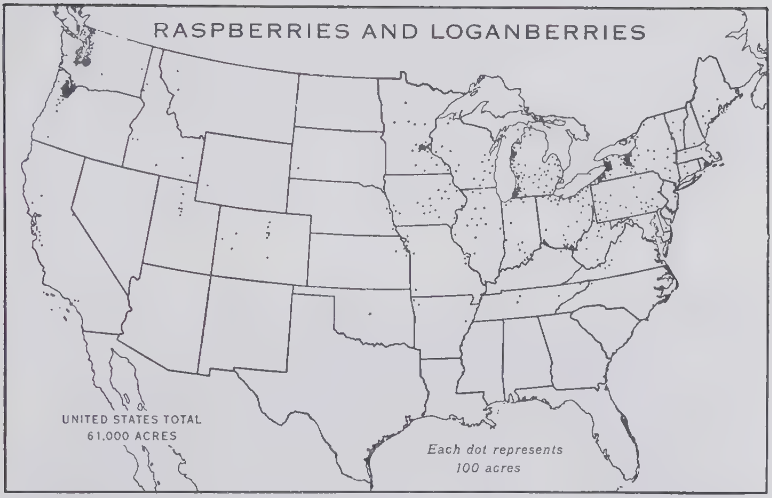


FIG. 141.—Acreage of raspberries and loganberries in the United States according to the last census. Most of the commercial raspberry plantings are north of the Ohio River and west of the Great Plains. Intensive production centers are also located in the Pacific Coast States. (U. S. D. A.)

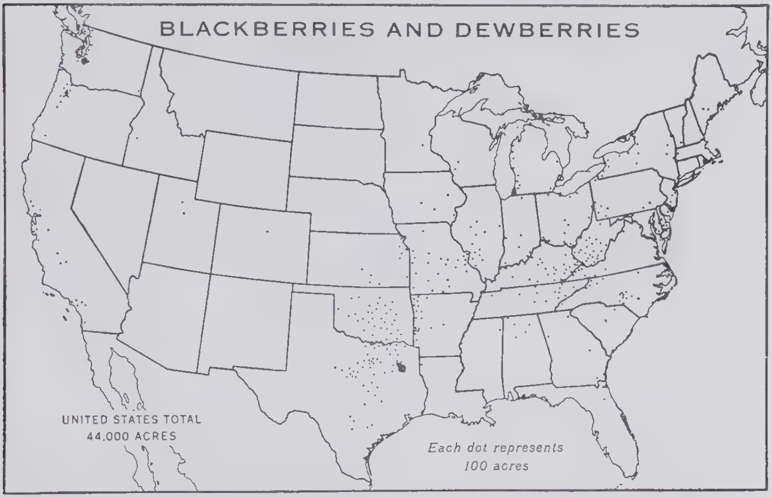


FIG. 141a.—Acreage of blackberries and dewberries in the United States according to the last census. The leading states are Texas, Oklahoma, Kentucky, Missouri, Washington, West Virginia, and Michigan. (U. S. D. A.)

Aims.—(1) The special adaptations of the different bush fruits to the region should be understood. (2) The values and uses of the different varieties of each group of fruits should be learned.

Problems for Study and Discussion

1. Inquire locally as to the best types of bush fruits for your region.
2. Debate raspberries and blackberries vs. currants and gooseberries for market in your region.
3. Make up lists of the best varieties of red and purple raspberries for your region.
4. Make a list of the best varieties of black raspberries and dewberries.
5. What are the leading varieties of currants and gooseberries from which you could choose?

FIG. 142.—Fruiting cluster of Alfred blackberry. Alfred is a new early ripening blackberry expected to be of value for both home and commercial planting. Two-thirds natural size. (Illinois Station.)

6. Compare the leading varieties of each of these types of fruit for market purposes; for home use.
7. Ask growers if resistance to disease is an important problem in choosing the variety.
8. Why should untried varieties be grown by the experiment station first?

Activities.—Make a wall chart showing lists of the best market varieties of each of these fruits.

Adaptations.—Soil conditions are an important consideration in choosing which of these fruits to grow. If soils are rather light, growers will probably prefer to grow black raspberries or dewberries, although black raspberries will grow well on the heavy soils if the soils are well drained.

Climate is important, particularly for currants and gooseberries.

Cool climate and cool soils are best for these. Better yields will be secured under favorable conditions. Blackberries and black raspberries may be injured where winters are very severe. Currants and gooseberries can stand hard winters better than the others. The principle should be borne in mind that fruits are more profitable when grown in their best natural environments. These climatic and soil conditions, as well as the market demands, should form the basis of the debate suggested in problem 2.

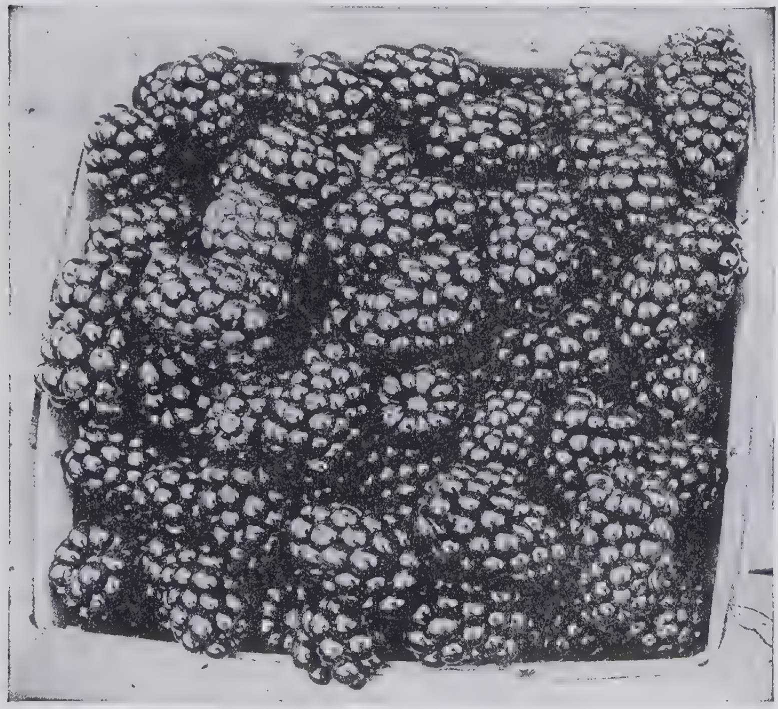


Fig. 143.—A basket of Lucretia dewberries that taste as good as they look. (U. S. D. A.)

Varieties of Blackberries.—Five types of blackberries are described in Bailey's *Standard Cyclopedia of Horticulture*. The natural differences among these types are found in blossoms, canes, thorniness, and hairiness. In order of popularity, the leading varieties from which to select those desired locally are Eldorado, Taylor, Snyder, Mersereau, and Ancient Briton. Descriptions of these varieties should be studied in nursery catalogs and in Farmers' Bulletins 643 and 728. New varieties of promise are Alfred and Brainerd.

Dewberries have fewer varieties. The Lucretia (Fig. 143) is popular. The Loganberry, Boysenberry, and others of trailing habit of growth, are very popular in the Pacific Coast Region.

Black raspberries from which to select are Black Pearl, Cumberland, Gregg, Logan, and Quillen. Bristol is promising.

Purple cane varieties of raspberries are popular in some localities. The leading varieties are Royal Purple, Potomac, and Sodus.

Red Raspberries.—These include Cuthbert, Chief, Latham (Fig. 144), Newburgh, and Taylor. Indian summer is a promising everbearer. Van Fleet may be of value in southern sections.

Fig. 144.—Fruiting clusters of Latham red raspberry. The Latham is very generally planted. It has proved profitable as a market berry. Two-thirds natural size. (Illinois Station.)

Currants.—There are two types of currants. The black currants are seldom grown commercially, but a few bushes are found in home gardens. Well-known varieties are Naples, Champion, and Prince of Wales.

Red currants with their albino or white variations are popular in the markets (Fig. 145). Among the outstanding red varieties are Cherry, Perfection, and Wilder. Red Lake is promising. Viking is resistant to rust. White varieties are White Grape and White Imperial.

Gooseberries.—This crop has been given much more attention in European countries than in America. The fruit growing wild in America is often used for food. Popular varieties of American gooseberries are Downing, Pearl, Josselyn, and Poorman. European varieties are Chau-

tauqua, Industry, and Whitesmith. The Glenndale is adapted to southern sections where other varieties are grown with difficulty.

Job 3. Propagating and Buying the Bush Fruits

Conditions Usually Found.—(1) Many growers propagate these fruits successfully. (2) Most growers buy the plants from good nurseries.

Aims.—The methods of propagating each of these bush fruits and of securing good plants from a nursery should be understood.

Problems for Study and Discussion

1. Ask growers regarding the advisability of propagating their own plants.
2. Describe methods of propagating blackberries and dewberries by root cuttings.
3. Tell when to make the cuttings and when to plant them.
4. Describe the propagation of black and purple raspberries by tip layering.
5. When and how should the tipping be done and when should the young plants be taken up?

Fig. 145.—The Red Lake currant, a new and promising variety originated by the Minnesota Experiment Station. (Courtesy Photographic Laboratory, University of Minnesota.)

6. How are red raspberries propagated by suckers?
7. Give directions for propagating currants by hardwood cuttings.
8. Give instructions regarding the propagation of gooseberries by the best methods.
9. When should lists be studied and orders placed for plants to be purchased from nurseries?

Activities.—(1) Fill out an order for all of these bush fruits for a home fruit garden, giving size, variety, and type of plant desired in each case. (2) Practise propagation of each of these fruits by the best methods.

Propagation of Blackberries and Dewberries by Root Cuttings.—When plants are propagated by cuttings made of the true roots, the roots are cut from the mature plants and are trimmed to suitable length, say three to six inches. These are dropped in furrows and covered. They may or may not be stored over winter, according to the cir-

cumstances or needs of the grower. One of the most common plants propagated by this method is the common blackberry. The dewberry, which is a close relative, may also be propagated by root cuttings.

It may be said that sweet potatoes are propagated by root cuttings, as they will grow readily from pieces of sweet potato, which are really true roots. There are no regular buds on the sweet potato or on the blackberry root; the shoots are formed at any suitable place, usually from adventitious buds. There is no regularity about the arrangement of the shoots arising from these roots.

Tip Layering.—When the tips of certain woody plants are bent over at the correct stage of development and covered with soil they may form roots and new shoots. Then when the parent branch is cut off a new plant is left growing at the point where the rooting took place. Black raspberries are most commonly propagated by this method (Fig. 146).

Fig. 146.—Tip layering of canes of the blackcap raspberry.

One Method of Propagation.—After the crop of berries has been picked is the best time to begin propagation by tip layering. Cultivate the soil between the rows thoroughly so that it is mellow and moist and free from weeds. In a rather straight row by the side of the parent plants bend down the longest canes, slightly break them on the under side a few inches from the tip, and cover them with some soil at the wounded points. Scores or hundreds of tips may be thus treated in a short time. If necessary clods of earth may be placed on them to hold them down. In light sandy loam it is sometimes necessary to hold them with pegs thrust deep into the soil. In a few weeks the canes may be examined and found to be provided with roots. The tips of the twigs which were not covered will form fresh leaves or new shoots. When new growth is thus established, cut off the parent canes connected with the old plants. This may be done with a spade or pruning shears. The new row of young plants may be left in place until late autumn or early spring. They are then taken up and planted in the new berry patch where they are to remain.

A Second Method.—In late summer when the young shoots of the season begin to swell near the end and assume a "snaky" or "rat-tail" appearance, they may be bent down to the ground in a circle around the plants and inserted into the soil straight down to a depth of about three inches. The soil is then firmed well about the tips. Roots will grow from the end

of the tip and a small white bud will form in the crown. Next spring before growth starts, these layers may be dug and moved.

Propagating Red Raspberries.—A number of shrubs are propagated by division of the roots. The red raspberry is one of the common examples among fruits. When underground stems send up shoots, the rows of red raspberries become wider and a plow may be used to turn up a number of these roots with their shoots attached. This is done in very early spring before growth begins. Gather up the shoots bearing suitable roots including a piece of the horizontal root from which the shoot originated. Tie them in bunches and heel them in until ready for planting. Root cuttings are sometimes used in propagating red raspberries.

FIG. 147.—Cuttings of grape, currant and other woody plants should be planted so deep that only one or two buds are seen above ground when the trench is filled.

Propagating Currants.—No definite rule can be given for the best time for planting the cuttings in the open garden or nursery row. Early in autumn after the leaves fall and the wood is mature, make the cuttings. Prepare the soil well by deep plowing and thorough pulverizing. A rich black loam is to be preferred as it will hold moisture well. A trench or furrow may be made with a turning plow or single shovel plow. Place the cuttings along the straight side of the furrow. (Fig. 147.) If simple, heel, or mallet cuttings are used one or two buds may be left protruding from the ground. An inch or two of the stem is enough, and the remainder should be in the ground even if the cuttings are eight or ten inches in length. Throw the soil back against the cuttings and firm it in place with

the foot. This will bring the moisture to the young plant and cause it to start growth. The distance between the plants should be arranged to suit the kind. Usually we should allow room for a hoe between plants in the row, and the rows should be far enough apart to allow the use of a horse cultivator, say three or three and one-half feet.

Propagating Gooseberries.—Hardwood cuttings, as described for currants, may be used in propagating certain gooseberries. Some American and most European varieties are more commonly propagated by mound layering.

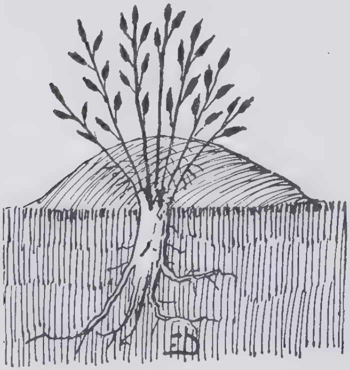


Fig. 148.—A mound of soil among the stems of the gooseberry will cause roots to form in this soil. Plants may then be multiplied by division.

Mound Layering.—This method obtains its name from the fact that the soil is mounded up among the lower stems or branches. The method is resorted to because of the fact that root division is too slow, or may not be possible because of there being only one stem arising from the ground.

When the soil is mounded up among the lower branches for a season, roots will be sent from the lower branches into this soil. (Fig. 148.) At the end of the growing season the whole plant may be taken up and divided by cutting these newly rooted branches away from the others. These may be planted as separate individuals.

Common Examples of Mound Layering.—The lilac, gooseberry, quince, althea, and others may be easily propagated by this method. Indeed, the method is a very sure one, as it does not in any way endanger the life of the parent.

Analogous to Root Division.—There is but little difference between mound layering and root division, except that in mound layering the gardener finds it necessary to mound up the soil among the lower branches to induce more roots to be formed on the stems already bearing buds or branches.

Job 4. Choosing the Location and Preparing Soil

Conditions Usually Found.—(1) Bush-fruit plantations are usually located favorably by the best growers. (2) Bad exposures are sometimes given for small plantations. (3) Favorable soil preparations are usually made.

Aims.—Good locations, proper exposure, and the best methods of soil preparation should be understood by students.

Problems for Study and Discussion

1. Compare the locations for the different types of bush fruits grown in your region.
2. Discuss proper slopes and exposure for commercial and for home plantations.
3. What exposure or aspect of slope is best for blackberries? For raspberries?
4. Which are best for gooseberries? For currants?
5. For which of these fruits are slopes most desirable? For which least necessary?
6. Describe a good method of preparing soil before planting.
7. How would you improve local soils before planting?

Locations.—The raspberry patch for home fruit should be located at one side of the garden where the bushes may be left undisturbed for some years. Near the house is better than off at some distance, because the fruit should be picked frequently. The vines should not be placed so that they are shaded throughout the day. Partial shade, however, may result in better fruit. The aspect of the slope is not an important consideration. Where hot west winds occur in the summer season, some protection on that side should be provided.

It is well to locate the blackberry patch where it will not be in the way of other garden crops. Along one side of the garden is a good place. The berries should be picked frequently during the ripening season and the patch should be located where it can be given attention at this time.

Exposure for Currants and Gooseberries.—These fruits are seldom injured by spring frosts, but as the plants thrive in cool soils and under cool conditions, an eastern exposure is preferred for commercial planting. In home gardens the shady side of a building or a place where shade is provided without robbing the roots of their plant food, as along the north side of a fence, may be chosen.

Soil Preparation.—Plow the soil well and if possible turn under some organic matter, such as green manure or barnyard manure, when preparing for a permanent fruit plantation of this kind. The crop is to remain on the soil many years. There should be no handicaps to begin with. Avoid soils which may have been infested with nematodes, as these enemies are certain to affect raspberries, blackberries, and dewberries.

Disk and harrow the soil well just before planting time.

Job 5. Planting and Cultivating

Conditions Usually Found.—(1) Mistakes may be made by beginners, but experienced growers have little difficulty in setting these plantations. (2) Good cultivation is too often neglected in home gardens and sometimes in commercial plantations.

Aims.—(1) Students should know the proper distances and good methods for planting each of the bush fruits. (2) They should know how to plan and carry out annual cultivation programs.

Problems for Study and Discussion

1. What are suitable distances for planting the different bush fruits where good culture is to be maintained?

2. Describe the laying out of a field for planting.
3. Give directions for proper handling and planting of plants.
4. What season is best for this work?
5. What conditions might require watering at setting time?
6. What pruning should be done when setting?
7. Why should clean cultivation be given? When may plants be mulched?
8. What implements would you use?
9. Under what conditions may an intercrop be grown among bush fruits?
10. Outline an annual cover crop and cultivation program.

Activities.—(1) Conduct trials to determine the best and most economical methods of setting plants. (2) By trials compare different intercrops with the bush fruits you have started.

Distances for Planting.—Blackberries, dewberries, and raspberries are commonly set in rows about seven feet or more apart, depending upon the systems of pruning and method of cultivation to be followed. The interval between plants in the rows is commonly $2\frac{1}{2}$ to 4 feet if they are to form hedge-rows. If the hill system is used, 5 by 5 to 6 by 6 feet is common for red raspberries. If the field is planted 5 by 5, 1,743 plants will be required per acre; 4 by 7 planting requires 1,556 plants.

A setting 3 by 5 feet requires 2,904 plants per acre. Currants and gooseberries are usually set at distances 3 by 5 to 5 by 8 feet. Every fourth row a middle is left 7 feet wide to aid in spraying.

Laying Out Rows.—As these plants are small, rows may be marked with a small turning plow or with a bulltongue plow. Distances in the row may be estimated or measured when planting.

Setting Plants.—Protect the roots of plants by handling them in a tank of muddy water on a stoneboat when distributing them along the rows. Never let the roots become dry. After a furrow has been run the plants are set rapidly by hand without using shovels. The soil should be well firmed about the roots. The tip bud of black raspberries should be lightly covered at first. If the season and soil are rather dry, watering may follow soon after planting.

Pruning when Setting.—In planting black raspberries, cut off the old cane or "handle," and burn to control disease. Other bush fruits need slight pruning when setting, but if plants are more than one year old the tops may need severe pruning. This should be done before setting.

Clean Culture.—Commercial plantations should always be given clean culture. It pays also to cultivate home fruit gardens. Use horse implements such as are used for vegetable gardens. Little hand work should be necessary except perhaps once or twice during the first summer.

A good annual program for a commercial plantation is to pursue clean, shallow cultivation until midsummer or a little later. Then sow a cover crop for winter. This may be a mixture of oats or wheat and vetch in northern latitudes or crimson clover in warmer regions. In the spring

this cover crop should be plowed or otherwise worked into the soil as green manure, and clean cultivation again pursued until midsummer. Cultivation should not interfere with picking. The most thorough work with implements should immediately follow the picking season. Mulching the rows aids in weed control and moisture conservation. (See frontispiece.)

Intercrops.—The first season or two an intercrop may be grown unless the plants have been set close. Not more than one row should be grown and that should be a very early crop which will be out of the way soon and will take very little plant food or moisture from the soil during the growing season. Early Irish potatoes may suit this purpose. Grow only one row of potatoes in a place.

Job 6. Pruning and Training the Bushes

Conditions Usually Found.—(1) Commercial growers usually prune bush fruits as closely as necessary. (2) They trellis or stake them satisfactorily. (3) In home fruit gardens pruning and staking of bush fruits are often neglected.

Aims.—The best practices in pruning and staking or other necessary trellising of bush fruits should be understood by beginners.

Problems for Study and Discussion

1. Observe commercial plantations and compare them with neglected fruit gardens.
2. Find which of these is producing the best and most fruit for a given area.
3. Describe the fruit-bearing habits of blackberries to determine on what date the blossoms and fruit are borne.
4. What annual pruning should be given blackberries?
5. Describe the fruit-bearing habits of black raspberries and tell what pruning would be best for this crop.
6. In what respects would the pruning of red raspberries differ from that of black raspberries? Why?
7. On what year's wood are currant blossoms and fruit mostly borne?
8. What pruning would agree with this method of bearing fruit?
9. Discuss the fruit-bearing habits and consequent pruning practices for gooseberries.
10. Describe good types of trellising for dewberries.
11. Under what conditions would staking or trellising for blackberries be advisable?
12. Describe trellising or staking for red raspberries.
13. Why are currants and gooseberries seldom staked or trellised?

Activities.—(1) Prune the bushes according to two different plans and compare results in growth and yields. (2) Prune a part of a blackberry or dewberry patch by mowing down and burning the entire growth above the soil promptly after harvest. On the rest of the patch save the young growth. Compare labor costs and results. (3) With some of these fruits test the value of trellising or staking.

Fruit-Bearing Habits.—The different bush fruits each have their own peculiar methods of bearing blossoms and fruit. There are some similarities among them. Blackberries and dewberries bear their fruit from shoots arising from wood produced the preceding year. Both black and red raspberries bear the blossoms and fruit on wood produced the

preceding year. The largest berries are borne on shoots from the basal and middle portions of the main canes of black raspberries, the size decreasing upward and outward.

Currants and gooseberries bear their blossoms and fruit chiefly on shoots arising from wood that is two years old, but some of the bearing shoots come from wood one year old and three years old. Even older wood may produce bearing shoots, particularly in gooseberries.

FIG. 149.—Summer topping the young shoots of a purple raspberry. Summer topping is necessary with blackberries and black and purple raspberries to induce the formation of strong lateral branches for the next year's fruiting. About three inches of young growth should be removed as indicated above. The purple raspberry, because of its greater vigor, is allowed to grow somewhat higher than the blackcap before being topped. (Illinois Station.)

Pruning Blackberries and Dewberries.—These fruits may be pruned heavily as soon as the crop is picked. Much of the wood to bear the next crop will grow after that time. In the most northern regions for these fruits, the best new shoots which appear before picking is over should be retained, but the rest of the wood may be cut away. In central and southern latitudes, the whole crop may be mowed down with a brush scythe or other implement and removed from the field immediately. The season should be long enough to allow the growth of new shoots from the crowns which will mature their wood by winter. This wood is to bear the crop next year. An application of fertilizer at this time is helpful.

This clean-up method is effectual in removing cane borers, anthracnose, and other enemies. The prunings should be burned.

When the new shoots from the crowns reach a suitable height, of two

and one-half or three feet, they should be clipped with a grass hook or other tool to make them branch. A rather large number of branches is desirable. This plan will induce more fruit clusters the next year. It

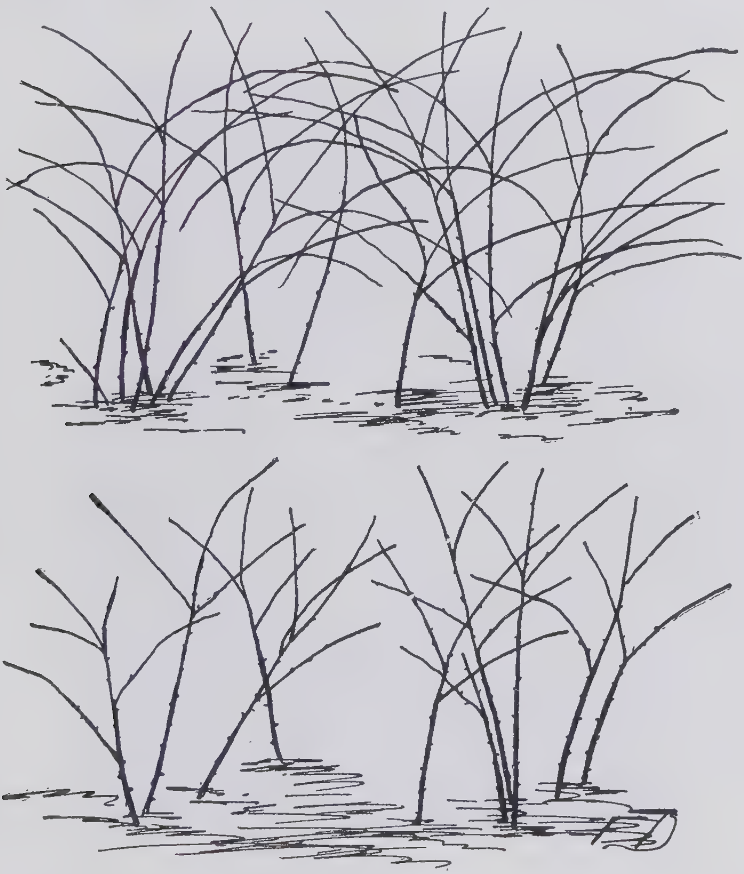


FIG. 150.—Black raspberry bushes before and after pruning. Dead wood is removed, the largest young canes left, weak laterals cut out and those remaining cut back to about 8 inches.

also prevents the canes of blackberries from becoming so tall as to need staking. Picking is easier if the bushes are not too tall.

Pruning Red Raspberries.—All old canes are cut away in the winter. The very strong and vigorous canes of last summer's growth are retained, and weak ones are removed by cutting at the surface of the soil. Probably not more than about 10 canes to four feet of hedge-row should

be left for fruiting. Where plants are grown in hills, eight canes per plant give best results. The main portion of each cane as well as any lateral growth should be headed back lightly, cutting being made to live wood. Somewhat heavier heading is warranted where the moisture supply is a limiting factor.

FIG. 151.—A form of wire trellis used for supporting raspberry canes. (U. S. D. A.)

Cultural methods should be used to promote the growth of large canes for the following year. Do not cultivate deeply; it injures the roots and increases crown gall.

Pruning Black Raspberries.—As the old canes furnish support to the new shoots, and as propagation from the old canes which bend and touch the soil may be practised, black raspberries are not commonly pruned after the fruiting season. Winter pruning is more common in most plantations. Cut away all but the last season's growth (Fig. 150).

A special pruning hook with a handle about three feet long is suitable for this purpose. The old canes should be cut at the top of the ground and pulled out and burned. Cut out all weak slender canes of the last summer's growth, leaving the strong canes. Head back with hand shears, leaving four to six buds on the pruned laterals. Short pruning makes more early berries and hence a more even picking season. Picking is easier and time is saved. The effects of drouth are less severe.

Pruning Currants and Gooseberries.—These fruits bear fruit on one-year-old wood and on one-year-old spurs from older wood. In pruning, the shoots which have borne fruit for two years should be removed. This applies to all plants three years old or over. This plan allows new shoots to take the place of old ones and growth is continually renewed. In the Pacific region the three-year-old canes are very productive, and shoots are left one year longer than in other regions. The drooping branches or those where the growth is too dense are removed. If the centers of the bushes are crowded they should be thinned.

Fig. 152.—One-year-old raspberries grown by the hill system, supported by single stakes. (U. S. D. A.)

Trellising and Staking.—Wire trellises are often erected for the support of dewberries. One wire eighteen inches from the ground is the commonest plan. In the warm climates two wires, one above the other, are sometimes used, and the canes are tied to them as with grapes. Blackberries and red raspberries are sometimes supported with wire trellises in which there are two wires at the ends of cross arms on the posts (Fig. 151). The two wires are level with each other and about two feet apart. The canes are allowed to fall over these either way. Other systems are sometimes used, some using one wire and others four wires.

Staking is in many sections a very common method of supporting bush fruits. One strong stake is driven by each bush and the bush is supported by tying (Fig. 152). This plan is common for red raspberries, occasionally used for dewberries, and rarely for blackberries and others.

Job 7. Controlling Enemies

Conditions Usually Found.—(1) A number of diseases and insects attack the bush fruits in all regions. (2) Commercial growers usually control these successfully. (3) Much damage is done and crops are often lost because of the damage in home fruit gardens.

Aims.—(1) Students should learn the characteristic attacks of different diseases and insects. (2) They should learn how to recognize and control each of these.

Problems for Study and Discussion

1. What damage has occurred in your region from cane borers? From crown borers?
2. Describe the attacks of these insects and how to control them.
3. What injury may result from raspberry sawflies? How are they controlled?
4. Describe the attacks of red spiders and suggest methods of control.
5. Describe the attacks of currant worms and suggest suitable remedies.
6. Outline plans for controlling San José scale.
7. Describe spraying methods to control plant lice.
8. What damage occurs from currant maggots? How are they controlled?
9. What is anthracnose? How controlled?
10. Describe orange rust and outline a campaign against this disease.
11. What is the nature of cane-blight disease? What spraying will prevent it?
12. Describe mildew on currants and gooseberries and suggest control measures.
13. What fruits are attacked by pine blister rust?
14. What can be done to prevent this disease?

Activities.—(1) Make tests to compare dusting with spraying in fighting leaf-eating insects such as currant worms. (2) Study the effects of sanitation and spraying in pest control.

Cane Borers.—Two types of cane borer attack raspberries, blackberries, and dewberries. The American longhorn beetle is the adult of the one most commonly found. Young growing canes are attacked by the adult laying eggs in the pith. To do this, the female makes two rows of punctures around the cane, half an inch apart. This causes the tips of the canes to wilt.

Control.—As soon as the wilting is noticed, the affected parts should be cut away and burned. If this is not done, the borers work down the canes and do much more damage through a period of two years. The beetles emerge in May or June after the two-year cycle. Thorough annual pruning will destroy cane borers completely if the canes are burned. Wild brambles near by harbor these insects.

Crown Borers.—In this case the adult is a moth which lays eggs on the leaves of the plants in late summer and early fall. When the larvae hatch they crawl into the stems and pass the winter at the base of the canes. This gives them the name crown borers. They hide in the roots and crowns all summer and pass a second winter in their channels, appearing about midsummer as adult moths. The attacks of this enemy often kill the plants. A sickly appearance of growth is noticed. Dead canes serve as a warning.

Control.—The first remedy is to dig out the larvæ or to dig out and remove affected parts. Rotation of the plantation is also recommended. Thorough pruning by the mowing method for blackberries and dewberries will destroy many of the crown borers. If disking the soil all over the crowns follows after mowing the tops, many borers may be destroyed. Larvæ are exposed to the attacks of birds.

Raspberry Sawflies.—These insects attack raspberries, blackberries, and dewberries. The adult is not a true fly but has four wings and otherwise resembles a fly. Eggs are deposited in spring on the under surfaces of the leaves. When the larvæ hatch they begin eating the surfaces of the leaves and when the soft tissues are gone they attack the young twigs. The damage consists in defoliating the plants and ruining or nearly killing the plantation.

Poisoning the larvæ during the early feeding stage is easily accomplished by spraying with arsenate of lead. If attacks occur very late, hellebore may be substituted to prevent poisoning the fruit. Use one ounce of hellebore to one gallon of water. Derris dust is good.

Red Spiders.—These minute mites are yellowish or reddish in color. They feed upon raspberry leaves and other plants. Their damage is most noticeable in dry seasons. Heavy rains stimulate growth and perhaps destroy the spiders. They suck the juices of leaves and cause injuries similar to attacks of plant lice.

Spraying with nicotine sulfate is probably the most common remedy but is not effectual. Dusting with sulfur is often satisfactory except on red raspberries, where it will cause leaves to drop. The sulfur may be blown on with a bellows. Experiments with soluble oils, sulfides, and synthetic organic compounds are being tried.

Currant Worms.—These insects are very commonly seen feeding upon the leaves of currants and gooseberries. The larvæ feed at first on the under surfaces of leaves and later attack the upper surfaces. The attacks are similar to those of the raspberry sawfly. Eggs are laid in early spring under midribs of the leaves. The larvæ soon hatch and begin feeding, usually working in groups. When fully fed, the larvæ form pupæ in trash about the bushes. From these the adults soon develop, and a second brood appears. The winter is passed in the pupa stage. This may be from the second or third brood, depending upon the latitude.

Spraying with poison, as arsenate of lead, is very effectual against this enemy. It should be done before the first brood begins its feeding on the under sides of the leaves. Keep the surface well covered with poison and no further trouble should follow. Neglect is certain to be followed by great numbers as soon as the second and third broods appear or by

the next year at the latest. It pays to spray currants and gooseberries as soon as the leaves appear, even if the insects are not seen. (Fig. 153.)

San José Scale.—This insect has been described in the apple enterprise. Fighting this enemy on the bush fruits, particularly on currants, is very important. Pruning and burning destroy many scale insects, but winter spraying on currants and gooseberries with the winter strength of lime-sulfur is recommended.

Fig. 153.—Wheelbarrow sprayer, handy for bush fruits, grape vines, in the home vineyard, or small strawberry plantations. (Illinois Station.)

Currant Borers.—The attacks of this insect are similar to those of the cane borers already described. The eggs are laid on the canes, and when the larvæ hatch they soon burrow into the canes and feed upon the pith. The injury consists in weakening and often killing the canes. The effects are most noticeable the second season. The pupa stage passes the winter in the canes. Adults emerge in May or June.

Close pruning and burning of the canes is recommended. Trimming off affected parts when the first attacks are noticed will be very helpful if practised diligently.

Plant Lice.—The attacks of plant lice have been described in the apple enterprise. The familiar appearance is well known to all close

observers. Currants are more commonly attacked by plant lice than are the other bush fruits. Sap is sucked from the leaves, which curl up and are of little value to the plant.

Control.—The first remedy is spraying with nicotine sulfate diluted with one thousand parts of water. To be effective the nicotine must be

Fig. 154.—Crown gall at the crown and on small roots of raspberry. The losses from this disease are always serious; frequently entire plantations have to be destroyed and the land planted to other crops. Nursery stock should be obtained from ground that is not infected. Deep cultivation cuts the roots and permits entrance of the causal organism. (Illinois Station.)

applied just after the eggs are hatched in spring. Thorough spraying will kill the stem-mothers and cut off most of the later infestation.

Currant Maggots.—The adults are true flies which lay their eggs on the young fruit or in the blossoms. The maggots soon hatch and feed inside the currants and gooseberries. The fruit soon falls to the ground and the pupæ are formed in the soil.

Methods of destroying the insects are difficult to apply. Poultry or pigs in the plantation may aid by picking up many of the larvæ and pupæ. Plowing and cultivating the soil will aid much in this.

Crown Gall.—This trouble is caused by gall-forming bacteria which attack the crowns and roots of blackberries and raspberries (Fig. 154). Galls and swellings appear on the roots of the plants. They are more common on raspberries than on blackberries. Red raspberries seem to be most susceptible.

Control.—Detecting affected stock from nurseries is important. Avoid planting on soils infested with the trouble. No known remedies of practical value have been discovered. Affected plants may be dug up and burned. If they are kept for another crop or two they should receive heavy applications of nitrogenous fertilizers.

Virus Diseases.—Several diseases of uncertain origin probably belong in the virus group. The most serious of these are mosaic, leaf curl, and streak. The last is chiefly found on black and purple raspberries. Attacks of these three diseases affect the leaves, canes, and roots and plants do not recover. Eradication and burning should be the remedy used. See symptoms in U. S. Farmers' Bulletin 1488. Several experiment stations are at work on the problem.

Anthracnose of Blackberries and Raspberries.—This causes spotting on the canes which is readily recognized. The spots are small at first and become larger. When spots run together elongated areas are formed. Cracking may follow the drying of the canes. Death occurs at the ends of the canes first. Girdling effects are noticed toward the base of the diseased area. Leaves and fruit are also attacked.

Treatment consists in spraying with lime-sulfur or Bordeaux, beginning when the leaves appear; pruning and burning affected parts; cultivation and fertilizing; removal of weeds and rubbish; and admission of sun and air. In warmer climates this disease has caused growers to mow and burn all canes just after harvest. The new growth shows little if any anthracnose. Newly set plants should be rogued carefully.

Anthracnose of Currants and Gooseberries.—This form of anthracnose is not the same organism and disease which affects raspberries and blackberries. It attacks the leaves most severely, giving a mottled appearance and causing them to drop. Canes may be affected and fail to ripen for winter. If leaves fall early the crop is reduced or lost.

Treatment.—Winter spraying with lime-sulfur and the use of Bordeaux through the summer are recommended. Wilder and Prince Albert currants are usually free from anthracnose.

Orange and Cane Rusts. Several related rusts attack the blackberry-raspberry group. Orange rust is most common, appears on leave-

earlier, and is darker in color than the cane rust. The latter continues later in the summer. Red raspberries are seldom affected with the true orange rust.

Treatment.—Dig out and burn plants affected with true orange rust, as the fungus occurs on the roots also. Cane rust seldom attacks the roots and mowing or pruning off the canes to be burned is sufficient. Never plant nursery stock started from affected plants. New plantings should have affected plants rogued out carefully. The most resistant varieties of

FIG 154a.—Knapsack sprayer demonstration in protecting low-growing plants, Baldwin County, Georgia. (U. S. D. A.)

blackberry are Snyder, Evergreen, Lawton, and Eldorado, which are rarely attacked. Lucretia is a resistant dewberry. Cuthbert and Antwerp are very susceptible varieties of raspberries. Black Caps are susceptible.

Leaf Spot.—Several diseases of leaves resembling anthracnose attack currants, gooseberries, red raspberries, dewberries, and blackberries. The control methods are the same as recommended for anthracnose.

Powdery Mildew.—The name of this disease describes the appearance. Leaves and fruit of gooseberries are often seriously affected. The American varieties are less affected than European varieties. A related form of mildew sometimes affects raspberries but does little damage.

Spraying with lime-sulfur is a good means of control if repeated often. Diseased parts may be pruned off and burned if cases are severe.

White Pine Blister Rust.—This European disease is now well established in Canada and from New England to the West wherever white pine trees are grown. Currants and gooseberries are attacked by the summer form of the disease. No other plants are affected. The disease may not spread more than 900 feet from these bushes to white pines except in the case of black currants. All black currants should be destroyed in the white pine belts as they are very susceptible and have been known to take the disease at distances of 100 or 150 miles. Then the other kinds are soon infected. Pines are killed by the disease. In regions where the disease exists currants and gooseberries should not be planted and nowhere should black currants be tolerated.

Job 8. Harvesting, Grading, and Packing

Conditions Usually Found.—(1) The technical knowledge required for these crops is less important than for some other fruit crops. (2) Commercial growers and others usually succeed well in harvesting, grading, and packing fruit properly.

Aims.—(1) Students should learn just when to pick the berry crops for market and for home use. (2) Proper methods of grading and packing should be understood.

Problems for Study and Discussion

1. Which of these fruits color before they are truly ripe?
2. What differences in maturity are there between fruit to be used at home and fruit to be shipped to market?
3. Make rules to govern the frequency of picking for each of these fruits.
4. Describe good methods of picking raspberries, blackberries, and currants.
5. What grading is advisable for each of the bush-fruit crops?
6. When and how is this done?
7. What are suitable containers for each of these fruits?

Activities.—Test by trials the value of repacking these fruits at a shed instead of grading, packing, and facing the baskets in the field at picking time.

Judging Maturity.—Blackberries and dewberries turn black before they are truly ripe. The shade of color is a good indication of ripeness for raspberries and currants. Gooseberries might be more popular if allowed to color and develop flavor before picking.

Fruit to be shipped long distances is picked earlier than that intended for local markets or for home use. Blackberries and dewberries are often picked as soon as the color turns black. They do not properly mature by this plan and the fruit is much improved in quality by allowing it to develop longer and increase in sugar content before picking.

Frequency of Picking.—These fruits should seldom be picked when they are wet with rain or dew. Allow the wind to dry them slightly before picking or thoroughly if possible. When the crop begins ripening the fruit

should be picked daily. Pickers cannot get all of the mature fruit each time and daily picking will prevent much loss and will produce a better product for market.

How to Pick Fruit.—From thorny bushes, fruit is picked by hands protected with gloves. The fingers may be cut from the glove if desired. Suitable gloves are those made of thin smooth leather, such as kid gloves.

Two fingers and the thumb should grasp the fruit with a light pressure and remove it quickly. The stems of raspberries should never be allowed to go into the containers. The fruit should be mature enough to come away from the "core" without crumbling. Currants are picked by the fingers, touching the main stem only, as when picking bunches of grapes. The pickers should lay the fruit promptly into berry boxes such as are used for marketing. These boxes are carried on trays holding four, six or eight boxes.

Fig. 154b.—Equipment used in picking berries. A carrier, made to hold a quart basket, is suspended from the waist. The baskets, as filled, are placed in a hand carrier and the carrier kept in the shade to protect the berries from the sun. (U. S. D. A.)

Containers.—For the earliest pickings, pint berry boxes are used (Fig. 143). These are familiar to all. Later in the season quart boxes are used except for red raspberries. About twenty-four quart boxes are packed in a ventilated crate together, eight boxes in a layer. The three layers are separated by thin wooden dividers.

Repacking.—In a packing shed handily located, the fruit is sometimes repacked, although it is the foreman's duty to see that fruit is carefully picked. This is more common for raspberries than for other bush fruits. The repacking consists in examining each box and removing leaves, stems, and other trash. Discolored fruit should be removed and the face of each box should be made attractive. The boxes are only slightly heaped for blackberries, raspberries, and gooseberries. For currants they are heaped more, to allow for the wilting of the stems.

Job 9. Marketing and Using

Conditions Usually Found.—(1) Coöperative marketing associations are less common for the bush fruits than for fruits grown more extensively in special regions, such as strawberries. (2) Methods of using the surplus crop are often overlooked and surplus fruits are often placed upon markets at reduced prices.

Aims.—The best methods of solving market problems and of using the surplus products should be understood by students.

Problems for Study and Discussion

1. Find what prices have been received by local growers for recent crops.
2. Study the methods of marketing followed by the best growers.
3. Review the advantages of coöperative marketing in other fruit enterprises.
4. Get opinions of local growers regarding coöperative marketing.
5. Inquire regarding the cost of a small canning outfit for canning surplus fruit.
6. How may fruit be dried?
7. What other preserving methods may be used for these fruits?

Activities.—(1) When any of these fruits are low in price conduct trials in making jellies and jams, or in canning the fruits. (2) Study the possibilities of a roadside market.

Markets.—The bush fruits are less popular on the markets than strawberries and orchard fruits. Consumers are familiar with the uses of raspberries, blackberries, and dewberries, but currants and gooseberries are less known in many regions and the consumption is rather limited.

Local markets are often used by growers having small plantations. Special catering to the particular needs of merchants and consumers may be necessary. Avoid placing fruit on the market which is in bad condition. Use clean packages and pack the fruit attractively.

Special advertising is often necessary for the development of new markets. Fruits placed in the best show windows with suitable placards may help. Written press-notices of the local fruit-growing enterprise may help in stimulating sales. Restaurants and other extensive users may be encouraged to stimulate use of fruit by a few sample boxes left for the purpose. A roadside market may be established where two good roads intersect. Put up good signs to attract the attention of auto travelers and have sufficient space for parking cars.

Uses.—Fruit juices may be made from raspberries, blackberries, and dewberries by slight cooking and sugaring. Sirup methods of preparing fruit juices are also used. Slightly underripe blackberries "jell" readily.

Currants are often made into jelly commercially.

Some blackberry and raspberry varieties lend themselves well to the comparatively new methods of preservation by freezing. See note on this subject on page 180 of the strawberry enterprise.

Job 10. Keeping Records

(See forms in apple enterprise.)

CHAPTER VII

HOME VEGETABLE GARDENS

In a number of the following chapters the vegetable-garden crops are fully analyzed and treated. Similar operations and management are often applicable in home gardens, or modifications may be made to suit special conditions. In the present brief chapter plans for home gardens are suggested. (See U. S. Farmers' Bulletins 218F, 353C, 406DC, 434F, 1044F, 1242F, 1390F, 1673F, 1746F.)

FIG. 155.—The surplus products from the home garden and orchard should be marketed frequently directly to consumers in the town market. First day of Holyoke market. (Massachusetts Agricultural College.)

Garden Plans.—Planning the garden in advance will be found much more satisfactory than just planting something because one gets "spring fever." Make plans in the winter, on paper, and order seeds early. Then take advantage of every good day to get the garden spot in shape, whether it is a tiny patch in the city back yard, the farm garden, or the big market garden—"Plan your work and work your plan" is a splendid slogan for gardeners.

The following garden plans may be found helpful in making such plans. They are to be adapted to your own needs. When home-garden projects are pursued surplus products should be sold and credit should be given to students conducting the garden for all products used at home.

Plan for a Home Garden, with Planting Dates

6′ Hotbed or Cold-frame	Seed bed for late plants of celery and cabbage, etc.

——Asparagus——

——Asparagus——Rhubarb——

18″
x——Parsnips 5/1, Salsify 5/1, Chard 4/8——
18″
x——Peas (Smooth) 4/8 followed by Late Cabbage* 7/1——
30″
x——Peas (wrinkled) 4/15 followed by Late Celery* 7/15——
30″
x——Beans 5/15 & 5/23 followed by Late Carrots 7/15——
30″
x——Beans 5/30 followed by Late Turnips 7/23——
30″
x——Cabbage† 4/15 followed by Late Beets 5/75——
18″
x——Carrots (two plantings) 4/8 & 4/23——
18″
x——Onions (seed) 4/15——
30″
x——Early Potatoes 5/1 followed by Fall Spinach 8/1——
36″
x——Midseason Potatoes 5/15——
18″
x——Early Beets 4/8——
18″
x——Late Potatoes 5/15——
36″
x Green Onions (sets) 4/8‡——Tomatoes† 5/30——
36″
x Lettuce† 4/15 & Radish 4/8‡——Tomatoes† 5/30, Peppers,† 5/30, & Egg-plants† 6/8——
36″
x——Early Sweet Corn 5/15 & 5/23——
36″
x Early Spinach 4/5——‡Late Sweet Corn 5/23 & 5/30——
36″
x Early Turnips 4/8——‡Bush Squash 5/23 & Cucumbers 5/23——
24″

* Transplants grown in seed bed.
† Transplants bought, or grown under glass.
‡ Remove only enough of the first crop to make room for planting.

A City Garden.—The following plan for a square-rod garden, published by the extension division of the University of Minnesota, is well suited to many village and city back yards. The figures at the right indicate the inches between rows.

Plan for a Square-Rod Garden

	12
..........Radishes and carrots followed by tomatoes..................	
	18
..........Early peas..	
	12
..........Early peas..	
	18
..........Radishes and carrots followed by tomatoes..................	
	18
..........Early peas..	
	12
..........Early peas..	
	18
..........Lettuce followed by tomatoes.................................	
	18
..........String beans..	
	12
..........String beans..	
	18
..........Spinach followed by tomatoes.................................	
	18
..........Early beets...	
	12
..........Early beets...	

Plan for a Farmer's Garden 100 x 200 Feet

Planting Dates		
	4′	Asparagus—Rhubarb—Winter Onions
	4′	Early Potatoes—followed by Late Turnips and Winter Radish
	3′	Early Potatoes—followed by Late Turnips and Winter Radish
	3′	Early Potatoes—followed by Late Turnips and Winter Radish
Apr. 1	3′	Early Peas—followed by Pickles—Turnips
	3′	Radishes—Leaf Lettuce—followed by Beans—Spinach
	1½′	Onion Sets
	1½′	Onion Seed
	1½′	Carrots—Salsify—Parsley
	1½′	Parsnips—Beets—Chard
	1½′	Radishes—Head Lettuce—Horse Radish
Apr. 10	3′	Peas—followed by Celery
	3′	Early Cabbage—followed by Beans—Cauliflower
	3′	Summer Cabbage—followed by Fall Spinach—String Beans
May 1	3′	Early Sweet Corn
	3′	Early Sweet Corn
	4′	Tomatoes
	4′	— — — — — —
	5′	— — — — — —
May 15	5′	—Cucumbers Summer Squash Winter Squash Watermelons Muskmelons—
	5′	—30 hills 5x5 ft. 30 hills 5x5ft. 30 hills 6x5 ft. 45 hills 6x5 ft. 50 hills 5x5 ft.—
	5′	— — — — — —
	4′	Sweet Corn
	3½′	Sweet Potatoes
	3½′	Eggplant—Pepper—Lima Beans
	3½′	Late Cabbage
June 1	3′	Late Potatoes
	3′	Late Potatoes
	3′	Late Potatoes
July 1	3′	Sweet Corn
	3′	

Another Farm-Garden Plan.—This garden plan, 90 by 240 feet, is taken from Circular 14 of the Kentucky Station. The space between rows will allow for horse tillage in most of the garden.

Farm Garden Plan, 90 x 240 Feet

Hotbeds — Cold-frames — Perennial Crops	7′–0″
Early Carrots — Early Beets	20′–0″
Head Lettuce — Leaf Lettuce — Radishes	
Onion Sets, for Bunch Onions, followed by Swiss Chard	
Onion Seed, for Big Onions, followed by Late Celery	
Early Peas, followed by Late Tomatoes	2′–6″
Midseason Peas; followed by Fall Cabbage	2′–6″
Early Cabbage; followed by Late Beans	3′–0″
Early Cauliflower; followed by Brussels Sprouts	3′–0″
Early Beans; followed by Late Cabbage	3′–0″
Early Spinach; followed by Late Peas	2′–6″
Kohlrabi; followed by Fall Beans	2′–6″
Bush Lima Beans; followed by Turnips	3′–0″
Okra; followed by Fall Spinach	3′–0″
Early Tomatoes; followed by Kale, Late Tomatoes, Peppers	5′–0″
Cucumbers — Muskmelons — Bush Squash	8′–0″
Watermelon — Winter Squash	6′–0″
Sweet Potatoes	4′–0″
	4′–0″
Early Sweet Corn; followed by Second Crop Potatoes	4′–0″
Early Potatoes; followed by Late Sweet Corn	3′–0″
Parsnips — Salsify	2′–0″
	2′–0″

240-ft. × 90-ft.

Planting Table.—The accompanying planting table will serve as a rough guide in planning and planting the home garden. Experience is a better guide. In the hardiness column, T means tender, killed by frost; VT, injured by cool weather; H, hardy, stands frost; VH, stands freezing of the soil.

*Planting Table for a Home Vegetable Garden**

Vegetable	Hardiness	Amount of Seed	Plants or Seed for a Home Garden	Planting Distances	Days to Maturity
Asparagus	VH	1 oz. to 800 plants	30 plants	18″ x 36″	3 yrs.
Bean (bush)	T	1 lb. to 50 ft.	4 lbs. seed	4″ x 16″	75 to 80
Bean (Lima)	T	1 lb. to 50 ft.	1 lb. seed	6″ x 16″	72 to 82
Beet	H	2 oz. to 50 ft.	1½ oz. seed	4″ x 16″	40 to 55
Cabbage (spring)	H	1 oz. to 2,000 plants	60 plants	18″ x 24″	90 to 110
Cabbage (fall)	H	1 oz. to 1,500 plants	75 plants	2′ x 3′	115 to 125
Carrot	H	1 oz. to 100 ft.	½ oz. seed	4″ x 16″	110 to 125
Celery Cabbage	H	1 oz. to 100 ft.	½ oz. seed	6″ x 18″	80 to 90
Corn (sweet)	VT	1 lb. to 100 hills	1½ lbs. seed	20″ x 40″	110 to 120
Corn (sweet, late)	T	1 lb. to 100 hills	1½ lbs. seed	2′ x 4′	90 to 110
Cucumber (pickling)	T	1 oz. to 50 hills	½ oz. seed	6′ x 6′	100 to 120
Cucumber (slicing)	T	1 oz. to 50 hills	¼ oz. seed	6′ x 6′	100 to 120
Eggplant	VT	1 oz. to 1,500 plants	18 plants	20″ x 30″	110 to 130
Kale	H	1 oz. to 2,000 plants	¼ oz. seed	8″ x 30″	100 to 125
Lettuce (head)	H	1 oz. to 2,000 plants	¼ oz. seed	4″ x 16″	90 to 110
Lettuce (leaf)	H	1 oz. to 150 ft.	½ oz. seed	6″ x 16″	70 to 80
Muskmelon	T	1 oz. to 50 hills	½ oz. seed	6′ x 6′	80 to 100
Okra	T	1 oz. to 1,500 plants	3 plants	12″ x 30″	100 to 120
Onion (sets)	H	2 lbs. to 100 ft.	1 lb. sets	4″ x 16″	55 to 65
Onion (seed)	VH	1 oz. to 100 ft.	1 oz. seed	4″ x 16″	115 to 120
Onion (plants)	H	1 pt. to 25 ft.	1 qt.	4″ x 16″	75 to 120
Parsley	H	1 oz. to 100 ft.	¼ oz. seed	6″ x 16″	50 to 60
Parsnip	VH	1 oz. to 40 ft.	¼ oz. seed	4″ x 16″	130 to 145
Peas (early)	H	1 lb. to 50 ft.	1 lb. seed	6″ x 16″	70 to 80
Peas (late)	H	1 lb. to 50 ft.	3 lbs. seed	6″ x 18″	65 to 75
Pepper	T	1 oz. to 1,500 plants	15 plants	18″ x 30″	110 to 135
Potato (Irish)	H	1 bu. to 5,000 ft.	2½ bus.	9″ x 30″	100 to 110
Potato (sweet)	VT	33 slips to 100 ft.	35 plants	36″ x 36″	120 to 130
Pumpkin (early)	T	1 oz. to 90 hills	½ oz. seed	6′ x 8′	90 to 110
Pumpkin (late)	T	1 oz. to 30 hills	½ oz. seed	6′ x 6′	90 to 110
Radish (early)	H	1 oz. to 100 ft.	1 oz. seed	2″ x 16″	25 to 35
Radish (summer)	H	1 oz. to 25 ft.	2 oz. seed	6″ x 16″	50 to 60
Rhubarb	VH	1 oz. to 50 ft.	12 plants	3′ x 4′	2 yrs
Salsify	H	1 oz. to 30 ft.	⅓ oz. seed	6″ x 16″	100 to 110
Spinach	H	1 oz. to 50 ft.	¼ oz. seed	4″ x 16″	50 to 55
Spinach (New Zealand)	T	1 oz. to 50 ft.	1 oz. seed	6″ x 16″	90 to 110
Squash	T	1 oz. to 50 hills	½ oz. seed	6′ x 6′	90 to 120
Swiss Chard	H	1 oz. to 50 ft.	½ oz. seed	6″ x 16″	75 to 85
Tomato (red)	T	1 oz. to 2,000 plants	60 plants	4′ x 4′	100 to 140
Tomato (pink)	T	1 oz. to 2,000 plants	½ oz. seed	4′ x 4′	100 to 140
Turnip (early)	VH	1 oz. to 100 ft.	⅓ oz. seed	3″ x 16″	115 to 130
Turnip (late)	VH	1 oz. to 100 ft.	½ oz. seed	Broadcast	100 to 110
Watermelon	T	1 oz. to 50 hills	½ oz. seed	6′ x 6′	100 to 120

* Kansas Agricultural Experiment Station Circular 181 (January, 1937).

Amount of Seed.—This varies with the grade of seed used. The best seed is always the cheapest and was used in obtaining these data. However, seed that is expensive because it is new or novel is not necessarily the best.

Planting Distances.—In rich soil plants grow larger and thus should be spaced further apart. Irrigation of any kind also results in larger plants. In a very rich garden soil where irrigation is practised, the number of plants may be reduced one third. The plots from which these data were obtained were better than average and irrigated as needed.

Days to Maturity.—These vary somewhat from year to year, with varieties used and care given the garden.

*Quantity of Vegetables Needed for an Adult Each Year**

Vegetables	Fresh	Stored or Canned	Number of Servings Each Week
Asparagus	2 lbs.	2 lbs.	1
Beans	10 lbs.	12 pints	2
Cabbage	5 lbs.	15 lbs.	1
Celery	2 lbs.	5 lbs.	1
Corn	35 ears	16 lbs.	2
Greens (*a*)	15 lbs.	15 lbs.	7
Melons	8 lbs.	8 lbs.	2
Onions	12 lbs.	30 lbs.	1
Parsnips	50 lbs.	75 lbs.	4
Peas	25 lbs.	15 lbs.	2
Potatoes (white)	50 lbs.	150 lbs.	7
Rhubarb	5 lbs.	10 lbs.	1
Rutabagas	10 lbs.	15 lbs.	1
Sweet potatoes	10 lbs.	15 lbs.	2
Tomatoes	30 lbs.	30 lbs.	3
Turnips	10 lbs.	15 lbs.	1

* Kansas Agricultural Experiment Station Circular 181 (January, 1937).

(*a*) Beet tops, endive, lettuce, spinach, New Zealand spinach, Swiss chard, turnip tops.

CHAPTER VIII

TOMATO, EGGPLANT, AND PEPPER ENTERPRISES

Analysis into Jobs.—These types of vegetables have similar operative and managerial jobs. All are warm-season crops and are started under glass. Their teaching units are therefore similar. These are listed below. References are given to U. S. Farmers' Bulletins unless otherwise stated. See also *Productive Vegetable Gardening,* L. C. Lloyd and *Vegetable Crops,* H. C. Thompson.

1. Determining possibilities with tomatoes, eggplants, or peppers.
2. Choosing the crop and variety, 160NP, 218C, 243C, 388C.
3. Selecting soil and field; deciding acreage, 1250.
4. Obtaining good seed; testing; treating, 25, 53C, 406DC, 1390F.
5. Locating, preparing, and managing plant beds, 1743F.
6. Preparing field for plants.
7. Setting plants and fertilizing.
8. Cultivating the crop; staking.
9. Controlling enemies, 1494F.
10. Harvesting, grading, and packing, 1291.
11. Marketing and using, 121MP, 141, 245C, 268T, 569D, 1291F, 1762F.
12. Keeping records.

Job 1. Determining Possibilities with Tomatoes, Eggplants, or Peppers

Conditions Usually Found.—(1) Tomatoes are extensively and successfully grown with profit by many truck farmers. (2) Eggplants and peppers are less commonly grown commercially. (3) These crops are grown in home gardens in all regions.

Aims.—Students should learn to consider carefully the factors involved in determining the possibilities with these crops: soils, climate, product, marketing, transportation.

Problems for Study and Discussion

1. Make a list of farmers who grow any of these crops for market.
2. Make a list of others who grow them for home use.
3. Ask regarding the amount of labor per acre required for any of the crops.
4. Estimate the investment needed for growing and marketing these crops.
5. What insects and diseases are likely to be serious in your region?
6. What local soils are most suitable for these crops?
7. Compare your climate and latitude with other regions producing these crops for market.

8. To what extent would your market be seriously handicapped by heavy production in other regions?

Projects.—Such vegetables as these may be grown by best methods as home projects. They may be managed as special truck crops or may be grown with other vegetables in a market garden.

Improving Soils.—Many garden soils need improving before planting these crops. This is particularly true for tomatoes. If a cover crop has been grown, spring plowing should be done rather early to give plenty of time for preparing the soil well. Disking before plowing is advisable to help work the cover crop into the soil and prevent a bed of organic matter under the furrow slice. Crops may suffer from drouth when the capillary moisture from the subsoil is cut off. As these crops are all transplanted, there is opportunity every spring to turn under a cover crop, as green manure, and allow time for preparing a good seed bed before it is time to transplant the plants.

Fall Plowing.—It is seldom necessary to plow the soil in the fall unless a very heavy, tough sod is to be rotted before the planting of these crops. Leaching and washing are more liable to take place if the soil is plowed in the fall. Level fields may be plowed in the fall with least loss.

Depth of Plowing.—If a heavy sod is plowed in the fall, the turning may be very shallow. This should be followed with deeper plowing in the spring, perhaps at right angles to the furrows made in the fall. Tough sod is thus worked well into the soil bed. Whenever green manure is to be plowed under in the spring, the disk harrow should precede the plowing, as already suggested, and the plowing should be rather deep. Avoid turning up raw subsoil.

Bare Fallow.—When these crops are desired for early market or for early home use, the soil should be thoroughly pulverized and warmed by maintaining a bare-fallow period between plowing and planting time. Use the disk harrow at least once and use a spike-tooth harrow several times. Air is thus allowed to enter the soil and percolation of moisture downward draws the warm air after it. Cutworms are controlled by causing them to develop early; all that are not destroyed by the implements and birds are transformed to the adult stage before the crops are set in the field. Weed seeds are killed by germination and subsequent harrowing.

Liming.—Many growers consider liming a benefit to these crops, chiefly because of the physical effect which it has upon the soil in making it finer and making the plant food in the soil available for the crops. The direct food benefits of lime for these crops have not been recognized. The tomato is tolerant of acid soils, while eggplant and peppers are more sensitive.

Regions.—If these crops are propagated in hotbeds they may be

planted out early enough to mature their crops in any latitude. The most intensive growing regions are those within easy trucking or shipping distance of the best markets.

Soils.—A wide range of soils is used for these vegetables. The light soils will stimulate early growth most rapidly, as these three groups prefer warm soils. When grown on heavy soils they suffer less from drouth, and starvation of the plants is less likely to occur.

Pests.—Tomatoes and eggplant are seriously attacked by troublesome insects and diseases. Tomatoes are sometimes nearly ruined by pests. Control methods have been found for most of these troubles, and growers can avoid losses by inexpensive methods.

Labor and Capital.—The labor requirements for these crops are heaviest at transplanting and marketing times. Marketing continues through a long period and much labor is involved in harvesting and marketing the products.

The investment necessary for producing and marketing tomatoes, eggplant, and peppers is fully as much as for most of the vegetable crops. Plants need to be propagated in hotbeds or plant houses, or they must be purchased from others. 3,600 to 4,800 plants are required per acre. These are usually set by hand methods, though machines are used in many instances for setting tomatoes. Staking, fertilizing, and spraying all require more or less capital.

Yields and Prices.—The 1935 average yields of these crops in bushels per acre are given below. The average prices at farms are also indicated.

	Production per Acre	Price	Receipts per Acre
Eggplant	244 bu.	$1.19 bu.	$291
Peppers	254 bu.	1.28 bu.	$325
Tomatoes (market)	121 bu.	1.89 bu.	$229
Tomatoes (cannery)	3.8 tons	13.93 ton	$ 53

Job 2. Choosing the Crop and Variety

Conditions Usually Found.—(1) Beginners are in danger of making mistakes regarding the growing of the proper crop and the proper variety. (2) Experienced growers seldom plant the wrong varieties.

Aims.—(1) Which of these crops and what varieties to grow commercially and for home use are problems for students to solve. (2) Adaptations of special varieties, resistance to disease and other factors should be considered.

Problems for Study and Discussion

1. Compare the number of local growers who grow eggplants or peppers with the number growing tomatoes. Compare areas also.

2. Get growers of eggplants and peppers to defend the growing of these crops.
3. Ask merchants which of these crops are most readily sold.
4. Make a list of tomatoes suited to your region in order of earliness.
5. Compare market varieties with varieties for home use.
6. What tomato varieties are known to be resistant to wilt?
7. What varieties of tomatoes would you grow for a cannery?
8. Suggest good varieties of eggplants.
9. What types of peppers are sometimes grown? Which of these suit your market or use?
10. Suggest suitable varieties of peppers.

Activities.—From fields and from markets collect the different types and varieties of these vegetables. Study them and have contests in identification. Identification tests may be made at fairs.

Fig. 158.—Tomatoes with smooth surfaces are much better for market than those with grooves. Compare 1 and 2.

Varieties of Tomatoes.—In the past few years great advances have been made in developing new varieties of tomatoes adapted to the various sections of the country in which they are to be grown. In the southern states resistance to the fusarium wilt is of prime importance and has resulted in the development of such varieties as Marglobe, Marvana, and others. In the eastern states Rutgers in New Jersey, Penn State

Earliana in Pennsylvania, and Indiana Baltimore in Indiana are particularly adapted to these sections, and others are in the process of development. For the northern and prairie states where short growing seasons require a very quickly maturing variety, the Bison from the North Dakota Agricultural Experiment Station is to be considered favorably.

The better known varieties including Bonnie Best, Chalks Early Jewel, Ponderosa, John Baer, Stokesdale, and many others have all been improved in recent years by seedsmen and growers. Certified seeds of the tomato are available in some states and where obtainable should be used.

In selecting a variety one must know the prevalent diseases and discard

FIG. 157.—Black Beauty eggplants. The boy is justly proud of his crop. (New Jersey Station.)

those varieties which are very susceptible to these diseases. Next he must select for earliness, productivity, and local market conditions. Tomatoes vary in general development in various environments but the general type remains constant. Types of tomatoes are shown in Fig. 156.

Wilt Resistance.—Fusarium wilt is difficult of control except by the use of resistant varieties. Strains have been developed from several of the better varieties which are resistant to this disease. The best known of these named in the order of early maturity are Marvel, Louisiana Red, Marglobe, and Gulf State Market. The first three are excellent early market varieties of red color. The last named is a good, thick-meated pink tomato which is replacing the Ponderosa in many sections. Marglobe has developed a decided popularity as a canning variety in the short period since its introduction.

Eggplant Varieties.—Outstanding are Black Beauty and Florida High Bush. Avoid choosing untried varieties or strains. (Fig. 157.)

Varieties of Peppers.—There are two main types of peppers grown for market and for home use, the hot peppers and the sweet peppers.

Fig. 158.—Sweet peppers are used both green and ripe. (New Jersey Station.)

Suitable varieties of hot peppers used for pickle sauce are Cayenne, Tabasco, and Creole. Good varieties of sweet peppers are Ruby King, World Beater, and Chinese Giant. The pimento type, a smaller, thick, sweet-meat pepper, is becoming increasingly popular. Pimento, Perfection, and Glory are suitable varieties.

Job 3. Selecting Soil and Field; Deciding Acreage

Conditions Usually Found.—(1) Beginners are prone to use too large areas for these crops at first. (2) They seldom make serious mistakes in selection. (3) Experienced growers know the danger of having their fields too large. (4) They usually know the advantages of strict rotation of crops.

Aims.—Students should learn to solve the problems of soil selection, field rotation, and acreage.

Problems for Study and Discussion

1. What local soils seem to be preferred for these crops?
2. What differences do you find in the choice of soils for the three kinds of crops?
3. In what ways may soils be improved for these crops?
4. Give special reasons for rotation of crops for tomatoes.
5. What are the dangers from nematodes if rotation is not practised? If it is?
6. Why should the inexperienced grower plant small areas?
7. For which of these crops would you plant large areas?
8. Give the amount of planting of each for market; for home use.

Tomato Soils.—This crop thrives best on medium heavy loams. As stated before, lighter soils warm up earlier and the crop may be forced more rapidly. It cannot endure cold muck soils.

Improving Tomato Soils.—There is little danger of having tomato soil too fertile. Either a light or a heavy soil may be improved by turning under a moderate supply of barnyard manure or green manure. This will lessen the harm done to the crop in time of drouth and will supply much plant food, particularly nitrogen. If possible, precede the crop with clover, soybeans, or other legumes turned under to enrich the soil. Any good sod crop turned under as green manure should help tomatoes greatly.

Soils for Eggplant and Peppers.—For early market crops, sweet peppers should have a light sandy loam. They do not endure heavy soils so well as tomatoes and eggplant. The latter thrive well on soils good for tomatoes.

Rotations.—In choosing a field for tomatoes, eggplant, or peppers, rotations of crops is an essential factor. This is particularly true for tomatoes. Avoid choosing fields which have grown crops affected with nematodes, such as some varieties of soybeans and cowpeas, cabbage, carrots, parsnips, beets, strawberries, and peaches. For the same reason, never grow tomatoes between rows of peaches, blackberries, or raspberries. Avoid soils for tomatoes which have previously grown tomatoes affected with wilt disease. This disease continues to live in the soil several years, and spraying does not control this pest. Grass crops, clover crops, vetches, rye, and other green-manure crops may be grown and turned under. They will contribute much to the soil and are not likely to affect it in any injurious way.

Size of Field.—Many commercial growers consider two acres of tomatoes a rather large field. Avoid having the field too large. There is much danger of neglecting a large field when the problems of spraying, staking, and picking are involved.

Very much smaller areas of eggplant and peppers should be grown. For home use, twenty-five to fifty tomato plants of two varieties and perhaps a dozen eggplant or peppers will satisfy most families.

Job 4. Obtaining Good Seed; Testing; Treating

Conditions Usually Found.—(1) Most growers buy seed with little attention to quality. (2) Testing and treating seed are uncommon practises. (3) Many successful growers consider it profitable to choose seed carefully and to test and treat the seed.

Aims.—Students should know the value and the methods of improving crops by careful selection of seed, and testing and treating the same.

Problems for Study and Discussion

1. Discuss with growers the question of buying seed vs. saving seed at home.
2. Give directions for saving and preparing seed from these crops for storage.
3. What are the usual commercial sources of these three kinds of seed?
4. Give arguments in favor of testing seed.
5. Describe an easy method of testing.
6. For what purposes should seeds be treated? Why?
7. Why should seeds be soaked?

Activities.—(1) Practise selecting seed plants and fruits according to best ideals and standards. (2) Rogueing a field of inferior and untrue and diseased plants is good practise when seed is being produced for market.

Saving Seeds at Home.—All three of these crops may be greatly improved by saving seeds at home. Choose early maturing fruit of good form and size, having good skin and good color, borne on heavy-yielding plants which are immune or highly resistant to disease. By this method much better seed may be saved from tomatoes, eggplant, and peppers. The quantity needed makes this a light job each year. It may pay to buy seed where conditions are unfavorable for making a careful selection on the home place.

Preparing Seed for Storage.—After careful selection, the fruits may be cut to pieces or mashed by some rapid method. The pulp is washed from the seeds by rubbing through coarse sieves under water. The pulp may be floated off and the best seeds will settle to the bottom. They should then be thoroughly washed and laid on sheets of cloth or paper to dry. After this they may be put in cloth or paper packages and stored in a dry place over winter.

Commercial Sources of Seed.—Tomato seed is produced in many regions and seed supplies are found in many of the trucking centers. Young growers should learn to rogue out plants carefully in fields intended for seed production. Cull out any which are not true to type, are unproductive, show diseases, or do not mature the crop at the proper time. Seeds for eggplant and peppers are commercially produced by the same methods and often in the same regions.

Testing Seed.—Low vitality is often found when testing seeds of these crops. Good samples of tomato seeds should test as high as eighty-five or ninety per cent. Eggplant and peppers are a little lower in vitality. If old lots of seed are secured, germination may be greatly reduced. Tomato seed can be kept successfully if necessary about three or four years. Eggplant seed last a little longer.

The beginner should understand that testing is less important with crops which are to be transplanted, as they are to be handled in the plant bed several times. This does not mean that testing will not pay. Wasted time in plant beds may pay for the cost of testing many times over.

Seed Testing.—A teaspoonful of seed is enough for testing each of

these small seeds. Some prefer counting out a definite number, as one or two hundred seeds. Spread each kind out thinly on a large wet cloth, then roll up the cloth like a rag doll and soak in water for twelve hours. Then squeeze out the water gently and place the dolls in a jar or vessel which may be covered to help hold the moisture. The cloth should be supported above the bottom of the vessel to prevent free water drowning plants as they germinate. Duplicate tests should be made for each variety. Keep the vessels in a warm place for several days. Then open up each row carefully and count the number of seeds which did not germinate well. Estimate or count to determine the percentage.

Treating Seed.—Seeds from diseased plants may carry germs into the soil when planted. All garden seeds should be treated before planting. There are several effective proprietary preparations. If these are used as directed on the container they will give good results. The seed must be planted as soon as it is sufficiently dry after treatment. Dusting with mercuric compounds is now being practised but the liquid treatment is better. The cheapest, and a very effective, treatment is bichloride of mercury. The directions for its use are given in the appendix.

Soaking Seed.—Germination of these kinds of seed and many other garden seeds is greatly hastened by soaking seeds before planting. If seed is treated as described, it may be soaked for twelve hours in the rinse water and then planted. Avoid drying the seed after soaking. The surface coat may be dried a little on blotters or cloth if desired, but a little soil rubbed with the wet seed should dry it sufficiently.

Job 5. Locating, Preparing, and Managing Plant Beds

Conditions Usually Found.—(1) Truck farmers usually construct and manage hotbeds and cold-frames to very good advantage. (2) Poor management is often the result with beginners.

Aims.—(1) The advantages and uses of hotbeds and cold-frames should be understood. (2) The proper locations and the details of construction and operation for best results should be understood.

Problems for Study and Discussion

1. What local growers use hotbeds and cold-frames?
2. Find the sizes and uses made of these.
3. How many growers sell plants to others?
4. Who among the market gardeners buy plants instead of growing them in hotbeds?
5. Describe the making of a hotbed to be heated with manure.
6. When should a hotbed be started for early crops of tomatoes, eggplants and peppers?
7. What are the temperatures for those plants at first?
8. Give directions for proper ventilation of beds.
9. What are the dangers of damping-off? How avoided?
10. What rules for watering should be followed?
11. When does a hotbed become a cold-frame?
12. Describe the shifting or transplanting of plants in the beds.

13. What are the advantages and uses of flats? Of paper pots?
14. What is meant by "hardening-off" plants? How accomplished?

Activities.—Hotbeds and cold-frames may be started and used for the production of plants to sell to other gardeners.

Purposes of Hotbeds.—The chief purpose of hotbeds is to start plants early enough to have them mature in time for market, or in some cases to get them to mature before fall frosts kill them. A secondary purpose of hotbeds is to grow vegetables to edible maturity out of their natural season. Examples of crops started early in hotbeds are tomatoes, peppers, eggplant, cabbage, kohlrabi, and cauliflower. Among the crops that may be grown to edible maturity in hotbeds are those which mature quickly and which do not require great heat. Examples are lettuce, radish, spinach and sometimes carrots, beets, and turnips.

Frames for Hotbeds.—The standard width of hotbed frame is six feet from the low side at the south to the high side at the north. In length east and west there is no limit. They are, however, commonly made into a length which is some multiple of three feet, that is, either three, six, nine, or twelve, etc. The low side of the frame should be about one foot above the soil inside. The high side should be about eighteen inches above the soil inside. The difference in height gives a slope to the glass covering toward the south so that the rays of the sun will enter the pit better.

How Frames are Made.—If pieces of two-by-four are placed in the corners of the frame and the boards nailed to these, the frame may be easily constructed. The two end pieces must be cut at a bevel to agree with the sloping of the bed. If a six-inch slope is to be given as suggested, a board six feet long and six inches wide may be marked diagonally from one corner to the other and sawed on this mark. This will give the two pieces needed for the two sloping ends.

Glass for Hotbeds.—Sashes made especially for hotbeds may be easily constructed. These have the supporting strips for the glass running from end to end without any cross piece except at the head of the sash and under the glass at the foot of the sash. These two hold the long strips in place. The glass may be of any desired length and of a width to fit the distance between the strips. There are two methods of placing the glass in the sash. (1) The glass may be "butted," that is, placed edge to edge. (2) The glass may be lapped about one-fourth inch so that the water will shed off as with shingles on a roof. The lapping is usually preferred, as heavy rains will not leak into the bed so badly.

Improvised sash may be used on hotbeds, that is, windows from any old building may be placed end to end, fastened together by two strips along their edges inlaid or screwed so as to hold the two halves. The entire window is thus used as one sash on the hotbed. In case such glass

is to be adapted for this use, it may be necessary to make the frames so as to fit the glass instead of making them of standard size.

Placing the Hotbed Frame.—It is best to dig a pit a little larger than the hotbed frame. This may be one to two feet or more in depth.

FIG. 159.

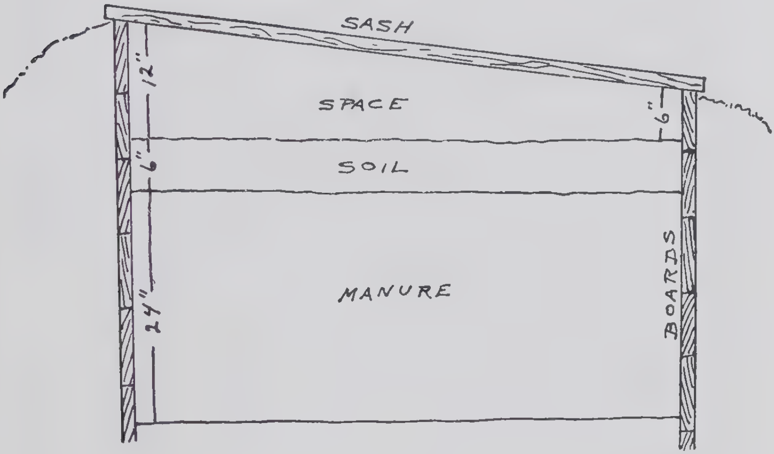


FIG. 160.

FIG. 159.—Plan of manure hotbed. The sash is three feet wide and slopes to the south.
FIG. 160.—Cross section of a six-foot hotbed. The bottom of the frame is placed a little below ground and a pit is dug about 18 inches deep. This is filled with fresh horse manure, on top of which is placed 6 inches of rich garden soil. The glass sash on top slopes toward the south to catch the sun.

Put about one foot of fresh horse manure in the bottom of the pit and tramp it thoroughly. Six or eight inches of good garden soil should be placed on the manure. A part of this may be put in place before the frame is lifted on the manure, but some of the soil should extend up into the frame

after it is placed. Compare these features in figures 159 and 160. Soil or manure should be banked up well around the outside of the frame to exclude all possible drafts of cold air. The glass may now be put on and after a few days the first extreme heating of the manure will be over. Then the soil is smoothed and watered, if necessary, ready for planting the seeds.

How the Manure Hotbed Is Heated.—There are two ways in which the manure hotbed receives heat. (1) The chemical change due to the rotting of manure gives off a great deal of heat. This being under the plants forces growth somewhat rapidly. If this heat is lacking the bed is called a cold-frame. (2) The sun heat is trapped by the glass and held in the bed. This is made clear by the statement that sunlight goes through clear glass without heating it, but when it strikes the soil or other objects inside, the light is changed into heat which cannot get out through the glass readily.

Electric Hotbeds.—Recently the heating of hotbeds by electricity has been developed to a point where it is very satisfactorily done. Lead-covered, well-insulated heating elements are strung on the surface of the soil to be used for starting the plants. The cables run the short length of the bed and are spaced seven inches apart. Two or more rows of seed are then planted between each line of the cable or wire. Where there are several hotbeds, or one very large one, thermostats may be economically used, but unless the area to be devoted to raising plants is over 500 square feet the thermostat cannot be recommended from an economy point of view.

The electrically heated hotbed does away with the need of manure, which in many places is becoming very scarce and often expensive. It is also sure, and one can sow the seed 24 hours after he has decided to operate the bed. Another advantage is the complete control one has over the temperatures so that the bed may be kept cool if the weather should turn warm early in the season or warm in case of a very late cold spell after the manure heated bed has begun to cool off.

The cables used for heating the beds cost about six cents a foot. The current consumed in heating the beds is not very great and in many cases costs less than manure plus the labor of preparing it for the beds. Power or light companies will often make special rates for electricity used for heating hotbeds.

Using Flats in Hotbeds.—Boxes about twelve by eighteen inches or larger, and four inches in depth, will be of use in growing seeds in the hotbeds. Fill the flats with three inches of soil and after planting the seeds in them place them on the soil in the hotbed. When transplanting time comes these are easily lifted out and taken to where the transplanting work is

done. In cold weather the transplanting should be inside to prevent chilling the plants.

Ventilation of Hotbeds.—On warm sunny days the beds will become too hot and ventilation is necessary (Fig. 163). A thermometer in the corner of the bed will serve as a guide to the gardener in this matter. Cool-season crops should not be required to stand a temperature of more than eighty degrees in the day time, and seventy degrees is better. Warm-season crops, such as tomatoes, peppers, and eggplant, may stand a temperature of eighty to ninety degrees.

Ventilation is accomplished by raising the sash at the north end and supporting it with two sticks at the corners of the sash. When the weather becomes very warm, the sash may be removed entirely during the day.

Ventilation not only controls the temperature of the bed but also supplies the necessary fresh air and helps keep surplus water vapor from

FIG. 161.—A trowel and a hand cultivator are necessary tools in the hotbed.

FIG. 162.—Two types of dibbles helpful in setting larger plants either in the hotbed or the garden.

accumulating inside. Too much heat and too much water vapor are certain to cause damage to the plants. Damping-off fungus is a common trouble in hotbeds and poor ventilation is likely to allow it to start.

Watering.—As the plants are growing under the cover, watering is a matter which must be given close attention. If too much water is applied, the soil will become soggy and the plants will turn yellow and suffer for want of air in the soil. If the bed is properly ventilated, considerable watering is necessary because the heat of the bed will dry out the soil. If the bed is filled with water, the manure underneath may stop heating. Light applications of water nearly every day are the best plan with the hotbed.

The Hotbed Becomes a Cold-frame.—After some weeks the manure in the hotbed will fail to give out heat because the rotting is advanced so much. In this condition it may be considered merely a cold-frame, as it gets its heat only from the sun through the glass.

Hotbeds which are started in late winter or early spring may continue their heat from the rotting manure long enough to last until the warm spring weather has come. The plants in the bed may no longer need artificial bottom heat.

Cold-frames Compared with Hotbeds.—The chief difference between a cold-frame and a hotbed is the absence of bottom heat in the cold-frame. In many cases, however, the cold-frame has no glass, but has in place of it a covering of muslin.

FIG. 163.—Students of Hampton Institute working in hotbeds and cold-frames. Methods of ventilating are here shown. (U. S. D. A.)

The muslin covers of the bed may be stretched and tacked on frames which are fastened in place by wooden buttons or may be merely laid upon the bed. In many cases the muslin may be tacked directly to the frame along the upper side. The other edge of the cloth is tacked to a strip of wood or pole which serves as a roller. To remove the cloth, the roller winds up the cloth as it is rolled toward the upper side of the frame. The bed is quickly covered by merely unrolling the cloth and letting the pole hang over the lower side.

Frames for Beds.—Sloping frames are not always constructed for cold-frames. Boards are placed on edge and nailed together at the corners and the cloth or glass is placed over the bed. It is not desired to have

very much heat; the frames may serve merely to protect the plant from the frosts or other extreme cold at night.

Uses of Cold-frames in the North.—In the colder latitudes one use of the cold-frame is to harden off plants which have been forced in the hotbed. Another use is to protect early spring crops which mature in short time, such as lettuce, radish, spinach, and carrots. As these plants are hardy and can endure some frost the frame merely serves as a protection from snow and cold blasting winds which would check the growth or even kill the plants.

Fig. 164.—Cabbage and cauliflower plants may be grown in cold-frames in winter for early spring setting. (Kentucky Station.)

In the northern latitudes, cold-frames are usually covered with glass so they will catch considerable heat from the sun (Fig. 164).

Management of Transplanted Plants.—The plan for shifting and final transplanting to the open garden of vegetables is often a puzzle to the beginner. The number of shiftings in the beds of the different kinds of plants is shown in the accompanying table. The dates are those published by the Illinois Station for Central Illinois, and allowance must be made for localities farther north or south.

Growing Plants for Sale.—This is found to be quite profitable, both in small quantities and on a large scale. Plants must be guaranteed true to name and free from disease (Fig. 165).

Directions for Growing Transplanted Plants

Crop	Dates of Sowing	No. of Shifts	Distances in Flats or Beds, or Size of Pots	Dates for Trans-planting to the Open
Onions	Feb. 1	0	Not shifted	April 10
Beets	" 20–Mar. 1	0	Not shifted	" 10
Head lettuce	" 20– " 1	1	2½″ pots	" 10
Early cabbage	" 20– " 1	1	2″ in flats	" 10
Early cauliflower	" 20– " 1	1	2″ in flats	" 10
Kohlrabi	" 20– " 1	1	2″ in flats	" 10
Tomatoes	March 1	2	2″	May 15
Peppers	" 1	2	2″	" 15
Eggplants	" 15	2	2″ in pots	June 1
Celery	" 15	1	2″ in flats	" 15
Summer cabbage	" 15	1	2″ in flats	May 1
Sweet potatoes	April 20	0	Not shifted	June 1
Muskmelons	" 20	0	3″ pots	May 15
Cucumbers	" 20	0	3″ pots	" 15
Late cabbage	" 20	0	Not shifted	June 15
Endive	" 15	0	Not shifted	Aug. 15

Job 6. Preparing Field for Plants

Conditions Usually Found.—(1) Home gardens are often poorly prepared for plants. (2) Most gardeners near large cities where land is expensive are most thorough in preparing garden soil.

Aims.—Efficient methods of preparing soils should be understood and practised by students.

Problems for Study and Discussion

1. How do local growers for commercial and home plantations improve soils for these crops?
2. What is meant by bare fallow before planting?
3. What effect does this method have upon attacks of cutworms?
4. What growers favor the use of lime on soils for these crops?
5. Discuss fall and spring plowing for these transplanted crops.
6. Discuss the depth of plowing for each season.
7. What implements should be used in preparing the soil between plowing and planting time?
8. Give full directions for their use.
9. What are the advantages of having a fine seed bed at planting time?

Activities.—Projects may include trials of different methods of preparing soils. Results should be contrasted by having all other treatments alike for the two areas compared (Fig. 165).

Plowing.—Fall plowing may be practised unless a winter cover crop is grown. If a sod or cover crop is to be plowed under in the spring, this work should be done early so as to allow the green manure to rot and become a part of the soil.

Harrowing.—A bare fallow should be maintained for a few weeks before planting, by harrowing the surface several times at intervals of a week, or by harrowing soon after heavy rains. This will tend to accom-

FIG. 165.—Project in growing tomato plants for sale. (Md. Exp. Sta.)

plish several purposes: conserve moisture, settle the lower soil, warm the soil, provide a good plant bed, develop and destroy cutworms and other insects, liberate plant food for the crop soon to be set, and destroy weeds.

FIG. 166.—Three good one-horse implements for garden culture. *A*, planker for crushing clods and smoothing the surface. *B*, spike-tooth cultivator for producing a loose mulch. *C*, shovel cultivator for more thorough and deeper tillage. *B* and *C* are adjustable in width. (Indiana Station.)

Planking.—Fields which are cloddy or otherwise rough should be planked just before marking off the rows for planting. Figure 166 shows

three horse-drawn implements which are valuable in large garden operations. The Meeker harrow, a combination pulverizer and leveler, is one of the very best tools for producing a fine seed bed.

Job 7. Setting Plants and Fertilizing

Conditions Usually Found.—(1) Many beginners and home gardeners make serious mistakes in time, depth, and manner of setting these plants. (2) Those growing these crops for market manage them more successfully. (3) Commercial fertilizing is practised in many regions.

Aims.—The best methods of successfully and rapidly setting these plants and of fertilizing them should be understood by students.

Problems for Study and Discussion

1. Ask successful growers to describe their methods of setting each of these kinds of plants.
2. At what times are the plants set in the open gardens?
3. Describe methods of marking rows or making furrows.
4. Describe best methods of setting tomato plants when they are rather tall.
5. How are plants protected from the wind and sun?
6. At what distances would you set each of these crops?
7. Give directions for fertilizing these crops at setting time and soon after.

Activities.—Speed and efficiency in planting may be the aims in contests. Different methods of fertilizing are suitable trials for projects.

Conditions for Transplanting.—The weather should be moist and the sky cloudy, or the transplanting may be done in the late afternoon. If rain is threatened, so much the better. Avoid hot, dry days for this work. The soil should be well supplied with moisture and freshly harrowed or planked, and the furrows freshly opened. Strong, stocky plants are best for transplanting (Fig. 167). Discard puny or diseased plants.

Marking out Rows.—Freshly harrow or plank the ground before marking. For large plants it is best to mark the rows with a bulltongue plow or small turning plow. This will give plenty of loose fresh soil for the planting. If planting machines are used, no marking or furrowing need be done in advance. Growers sometimes mark the rows with lines or with markers, but these methods leave no loose soil to assist in setting the plants. In such cases a dibber or trowel would be used for planting.

Distances for Planting.—Rows and plants are usually placed about three feet or four feet each way. If tomatoes are to be staked and pruned, the distances between plants may be less than when they are allowed to spread.

Planting.—If a furrow is opened for each row, hand methods of planting are most satisfactory. The work may be done rapidly if a boy distributes the plants and covers the roots a little ahead of the regular planter. Plants should always be set deeper than they were in the plant bed. Tomato plants should be much deeper. Tall slender plants may be laid along the furrow and the tops bent upward as the soil is firmed upon the

plants. This plan allows roots to form all along the stems, and resistance to drouth and disease are more certain.

Watering and Protecting Plants.—Watering by hand methods is expensive and should be omitted if good results can be obtained without it. If the sun is hot or the wind is strong, plants should be covered after transplanting, using large leaves, paper, or other shading materials. This work adds greatly to the expense of the crop. If conditions can be obtained that avoid this expense, production is more economical.

Fertilizing.—Tomatoes require much plant food. They suffer more from diseases and produce poor growth if not properly fed. Nitrogenous commercial fertilizers should be applied after the growth begins. Nitrate of soda may be applied to stimulate the growth at first. A little placed about each plant soon after setting or at setting time may be worked into the soil at the first cultivation. The other forms of commercial fertilizer, including superphosphate and potash, may be incorporated with the soil prior to setting the plants. Potash stimulates fruit formation and improves the quality of fruit. Light soils need more potash than heavy soils. Superphosphate tends to increase yields and hasten maturity of the fruit.

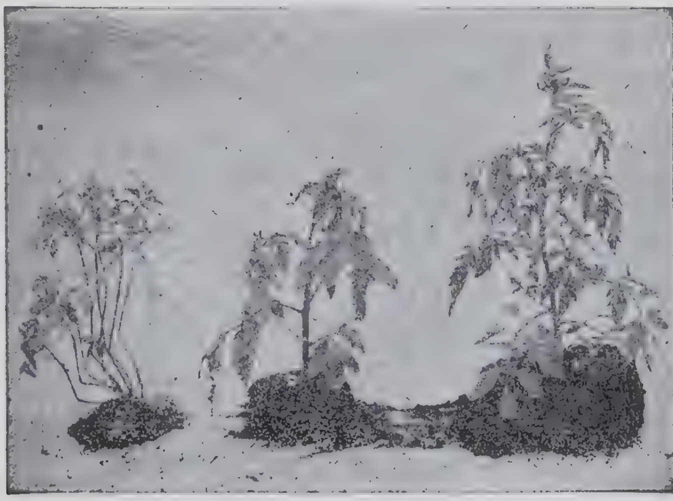


FIG. 167.—Tomato plants all of the same age. From left to right; not shifted, shifted once, and shifted twice. (Illinois Station.)

Job 8. Cultivating the Crop; Staking

Conditions Usually Found.—(1) Home gardens are usually well cultivated and plants are properly staked and pruned. (2) Commercial growers in some regions

care for the crop well until prices decline and then neglect the fields. (3) Staking of tomatoes is not always practised in commercial plantations, particularly on sandy soils. (4) Eggplant and peppers are rarely staked or pruned.

Aims.—Economical and efficient methods of cultivating, staking, and pruning should be understood by beginners.

Problems for Study and Discussion

1. How early should cultivation of these crops begin after setting is over?
2. What implements would you use in cultivating the garden?
3. How deep should tillage be made at first and later in the season?
4. How many cultivations would you give before staking tomatoes? How many afterward?
5. Ask growers the relation of cultivation to soil diseases of tomatoes.
6. What methods of staking are followed in your region?
7. What pruning is advisable to induce early ripening?
8. Compare the expense of pruning with the result obtained.

Activities.—Staking and not staking should be contrasted under conditions which are otherwise alike. Compare different methods and frequency of cultivation.

FIG. 168.—Staked tomato vines in North Dakota. (U. S. D. A.)

Implements.—For tillage of these crops the implements used are similar to those for corn and for other larger garden crops. Hand hoeing is expensive and should be used only for the removal of weeds near the plants. Use horse-drawn implements or motor cultivators as far as possible to reduce the expense of tillage. When these crops are grown in rows both ways, much of the hand work may be omitted.

Shallow Level Culture.—Shallow level tillage is advisable most of the time, but rather deep cultivation may be given soon after the setting of the plants. A little ridging near the end of the cultivation period is sometimes given. The belief among growers that ridging will help to

prevent tomato wilt is probably erroneous. The crop should be laid by with little or no ridging.

Frequency of Cultivation.—The chief purpose of cultivation is to destroy weeds. It is well to maintain a good soil mulch while controlling weed growth. Frequent early shallow cultivations should be given to

Fig. 169.—Tomato plants are sometimes pruned to a single stem and supported by tying to a stake. (*Productive Vegetable Growing.*)

destroy the weeds while small. Cultivation should usually follow heavy rains, especially on heavy soils. It is not advisable to cultivate during dry weather. The roots of these crops almost completely occupy the surface twelve inches of soil and care should be exercised not to injure them by needless deep tillage.

Staking.—Usually stakes are driven in the ground for the plants, one stake to each plant (Fig. 168). Tying up of the plants must be attended to

several times to prevent new growth from hanging down. Tomatoes produce more early marketable fruit freer from disease when properly staked and tied. Stakes may be removed each season and used for several years.

Pruning.—This consists in pinching out side branches arising in the axils of the leaves. To induce early ripening, growers often prune the plants closely (Fig. 169). This forces the nourishment into the first fruit clusters. Later blossoms may be pinched off or the tops of the plants removed for the same reason. A part of the garden may be pruned closely and the remainder left to produce later fruit. The removal of a portion of the foliage, except the old bottom leaves, probably has no value.

Job 9. Controlling Enemies

Conditions Usually Found.—(1) Serious diseases and insects make heavy inroads on yields when control methods are not practised. (2) Commercial growers are usually more diligent in fighting these enemies.

Aims.—The nature of the attacks of insects and diseases, the life histories, and the best methods of controlling each should be understood by beginners.

Problems for Study and Discussion

1. Give an account of the work of horn worms and tell how you would control them.
2. Describe methods of controlling plant lice.
3. What other crops are attacked by tomato fruit worms?
4. How are these worms controlled?
5. How can you distinguish between the attacks of blight and wilt diseases of tomatoes?
6. Give control measures for each of these.
7. Review the methods suggested for preventing attacks of nematodes. (Job 3.)
8. Outline the life history and the damage of potato beetles and blister beetles on eggplants.

Activities.—(1) Conduct trials showing different methods of controlling certain diseases and insects of your region. (2) Collect specimens of diseases and insects.

Tomato Horn Worms.—Large green horn worms are commonly found on tomato plants. They destroy the leaves and if not checked will ruin the crop. The eggs are laid by large "hawk" moths which fly at twilight, laying eggs on different parts of the plants. The worms are similar to those which attack tobacco.

Spraying or dusting with arsenate of lead before the worms become numerous is very effective. After the fruit begins to ripen, this method must cease unless the fruit is washed before marketing or using. Worms must be controlled before the crop reaches maturity.

Tomato Fruit Worms.—This worm also attacks corn ears in the roasting-ear stage. It is sometimes called the corn ear worm and also the cotton boll worm. Usually the end of the tomato opposite the stem is attacked by these worms.

Control Measures.—Because these insects prefer corn to tomatoes, a method of control for tomato fields is to have green corn growing near the tomato patch as a trap crop. It is also well to plant the tomatoes at some distance from a corn field if several plantings of corn are not maintained, as it is in the early stage that the insects prefer the corn. Spraying or dusting with arsenate of lead will aid in fighting fruit worms.

Cutworms.—These enemies attack many garden crops as they are first started. They are worst in cool spring weather. The larvæ eat from the plants at the top of the soil at night and hide beneath the surface during the day (Fig. 170). (See Job 3 in regard to the benefits of bare fallowing before planting.) Clover or bran mash sweetened with molasses and poisoned with arsenate of lead may be scattered around the plants. This will destroy many cutworms.

Fig. 170.—To protect from cutworms put paper cylinders or tin cans without bottoms around the plants as they are set out in the garden.

Stem Borers and Leaf Borers.—Dusting or spraying with poisons are good methods of preventing attacks of these two enemies.

Plant Lice.—Tomatoes, eggplant, and peppers are all attacked by plant lice. Sometimes the results are very serious. Spraying with nicotine sulfate is less difficult than for melons because the leaves are more easily covered with spray material. Nico-dust (a mixture of nicotine sulfate and lime) is very efficient when properly applied.

Blister Beetles and Potato Beetles.—These two enemies of eggplant are often very destructive. Their attacks are familiar to all growers. The methods of control are the same as those in common use for these enemies on Irish potatoes. Spray or dust the plants with poison as soon as they are set in the garden. Keep the new growth covered to protect from the attacks of the beetles. Arsenate of lead will not be washed off as easily as other poison materials and will not injure the foliage.

Two Common Tomato Diseases

Fusarium Wilt.—The wilt is recognized in its early stage by a wilting and an upward and inward rolling of the leaves. The upper part of the plant is the first to show the effects of the disease. A cross section of an infected stem shows a dark brown discoloration between the pith and the bark.

The organism causing the disease winters in the soil. As the plants are growing the fungus enters the roots, growing up inside of the plant. This is the cause of the discoloration between the bark and the pith. This fungus growth clogs the water-carrying cells, causing the wilting of the plant. On account of the location of the injury, there is no spray which will control this disease.

The only methods of control are rotation of crops and the growing of resistant varieties. The rotation should be a 4- or 5-year rotation. The intervening crops should include one soil-building crop, as clover or cow peas, and one cultivated crop, as sweet potatoes, melons, or corn. Crops related to the tomato, as peppers, eggplants, and white potatoes, must be avoided. There are a number of resistant varieties of tomatoes. Among these are Rutgers, Stokesdale, Gulf State Market, and others.

Leaf Spot.—The tomato leaf spot is serious in wet seasons. It appears on the leaves as water-soaked spots which finally turn brown. A yellowing of the leaf takes place and the edges begin to roll and the leaf finally dries up and drops off. The lower, or older, leaves die first but the disease works upward and often the plants are defoliated before the crop is half made.

The control of this disease is simple. When the spots begin to appear on the leaves, spray the plant with 3–5–50 Bordeaux mixture. It is hardly practical on a large scale for a late crop but for the home garden or an early crop results secured indicate that it is practical. Rotation of crops, as recommended for the wilt, is also of value in the control of leaf spot.

Thoroughness is of extreme importance in this spraying operation. Both sides of all leaves, diseased and apparently healthy, must be completely covered with the spray material. Often this requires a helper who will turn the vines after one side has been sprayed. Avoid spraying in dark or cloudy weather. Spraying may be repeated three or four times if rain washes it off.

Arsenate of lead and nicotine sulfate added to the Bordeaux mixture will control most insect pests.

Job 10. Harvesting, Grading, and Packing

Conditions Usually Found.—(1) Growers having experience with these crops for market purposes usually practise good methods in harvesting, grading, and packing. (2) Special methods of harvesting, grading, and packing are used in some regions and are not familiar to growers elsewhere.

Aims.—Students should understand the importance and best methods of harvesting, grading, and packing each of these crops.

Problems for Study and Discussion

1. Find from local growers the stages in which each of these crops is picked for market. For home use.
2. Show the relation between early harvesting and prices received.
3. Into what grades should these crops be sorted?
4. Find local practices regarding the removal or leaving of calyxes of tomatoes when packed.
5. What containers are used for packing each of these fruits for market?
6. Describe the preparing of green-wrap tomatoes for market.
7. Also describe the packing of ripe tomatoes.
8. Discuss with growers and with merchants the advisability of picking sweet peppers when green. When ripe.

Activities.—Speed and skill in harvesting, grading, and packing may be the aims in contests.

Judging Maturity.—Tomatoes are better for home use and for local markets if allowed to become fully ripe before they are picked. The green-wrap product is picked when the tomatoes are of a whitish green just before turning red. All degrees of ripeness between the green and the dead-ripe stages are found in freshly picked tomatoes. Tomatoes to be shipped long distances are picked rather green. They color readily after picking.

Peppers are picked in both the green and the red stages. Some markets prefer green sweet peppers while others demand that they be of mature color, (red or yellow). The green stage is probably growing in popularity. Eggplant should be fully colored before picking (Fig. 171).

It is important that tomatoes be picked as soon as they are ripe enough. Peppers and eggplant have a wider range of picking dates, as the fruits may hang on the plants longer without injury.

Relation of Earliness to Price.—The origin of green-wrap fruit is based upon the fact that early marketing will yield better prices. Customers seldom buy green-wrap tomatoes. They are usually allowed to color well before customers take them. However, a few days are saved by picking early and having the fruit in market by the time the ripe color appears. Earliness with peppers and eggplant is of less importance than with tomatoes. Pruning tomatoes to get early maturity was discussed in Job 8.

Grading.—Tomatoes are graded according to size, shape, smoothness, and color. Each package should contain a uniform lot in these respects. Peppers and eggplant are both graded according to size, shape, and color.

The calyx and stems are usually removed from tomatoes when or before they are packed. Some markets, however, demand that the calyx be left on the fruits to indicate freshness. This demand is gradually disappearing. The packer should understand the requirements of the market where fruit is to be sold.

Fig. 171.—Good specimens of eggplant ready for market. (Illinois Station.)

Containers.—Green-wrap and other very early tomatoes are usually packed in gallon baskets, six of which make up a crate, known as a Georgia carrier for peaches. Early peppers are often packed in similar containers. Hamper baskets are used for fruits of all these kinds later in the season. These are of sizes to suit the market. Eggplant fruit is often packed in crates without baskets. This plan suits the large-fruited varieties

Wrapping fruits when packing is a plan which seems to be growing in popularity. Peppers, eggplant, and tomatoes are now often wrapped for shipment. The plan has several advantages: (1) less rotting of fruit; (2) less shaking of fruit in the package; (3) more careful handling by pickers and packers.

Job 11. Marketing and Using

Conditions Usually Found.—(1) Poor methods of marketing are too often found. (2) Systematic coöperative marketing is a very modern method for tomatoes and for some other commodities.

Aims.—(1) The best methods of marketing should be understood to reduce losses and bring better returns. (2) Methods of using these products or canning them for use or sale later should be understood.

Problems for Study and Discussion

1. Study losses of truck farmers who do not market their crops coöperatively.
2. Ask them how their mistakes can be avoided.
3. Describe the selling of vegetables through commission men.
4. Enumerate the steps which might occur in marketing these vegetables when shipping to large cities.
5. Outline the main points of agreement for a coöperative marketing association.
6. What is meant by commodity marketing?
7. Describe the qualifications of a good market manager.
8. Make a list of the dangers involved in coöperative marketing.
9. What uses are made of these vegetables in your community when market prices are low?
10. Locate the nearest cannery for your region.
11. What prices are usually paid per ton by canneries?
12. What are the advantages of growing a crop under contract for a canning factory?

Activities.—(1) Vegetables may be offered for sale along with other farm products in roadside markets and curb stands. (2) Make and mount a suitable farm bulletin board on which to advertise vegetables and other products for sale.

Selling through Commission Men.—This plan is often fraught with grave dangers. The business of a commission man is to receive produce shipped in his name and offer it for sale in the market where he is located. He does not buy it himself. He charges a commission on the sales, pays the freight on the shipment, if possible, and returns the proceeds to the shipper. Though perfectly honest and diligent in trying to get the best prices for the produce, he may still fail in satisfying the shipper. The market may be overstocked at the time the produce arrives. It may be received in bad condition. His own market house may be too crowded with the particular product when the rest of the market is not overstocked. He is not necessarily to blame for these conditions. He is not always notified in advance before shipment is made. He does not know how many shipments are coming at the same time and does not know what other commission men and dealers may be receiving at the same time. He has no right to refuse shipments sent to him if they come up to the requirements of the market. He cannot be blamed for gluts of the market.

When all phases of selling through a commission merchant are considered, the grower should conclude that it is one of the poorest methods that can be found for selling perishable produce.

A Coöperative Association.—In recent years many coöperative

marketing associations have functioned successfully in marketing certain commodities. These are often spoken of as commodity marketing associations. Celery associations, for example, may handle that crop only.

The functions of such associations may be enumerated. (1) They attend to the proper grading and packing of the crop. (2) Diseased or low grade products are kept out of the market. (3) Packing materials are usually purchased by the association. (4) The association may own a good packing house for the proper washing, handling, grading, and labeling of the crop. (5) Markets that are not too crowded are located if possible. (6) Buyers are often brought to the packing house to bid on the crop. (7) The crop may be sold by the association in the field or for delivery at the shipping point. (8) Money is often borrowed by the association on the crop and advanced to the growers to aid in harvesting. (9) Some associations maintain a selling agency in several of the best markets. (10) Returns are made by the association to the different grower-members according to the grades and prices received.

A Good Manager.—Such a man is an essential part of a coöperative association. He must think rapidly; act quickly; decide firmly; reason carefully; be just to all members; know the details of the business; and be strictly honest.

The Dangers in Coöperative Marketing.—These are lurking everywhere. Members are not always true to the association. Outside buyers are often trying to get members to sell outside. Other concerns try to employ a coöperative manager. Deception is sometimes practised. Dishonesty is sometimes revealed. Associations sometimes fail to accomplish their purpose because some of these dangers exist.

Growing for Canneries.—In many regions tomatoes and to some extent the other vegetables are grown extensively for canneries located in the vicinity. Contracts are made whereby the operator of the cannery agrees to pay a stipulated price for the product delivered in suitable condition at the cannery. Such prices are usually very low compared with market prices for the same vegetables, but there are several advantages in selling to a cannery: (1) The grower is certain of a market; (2) he knows he will have no surplus product left on his hands; (3) he is not required to sort the product as the whole crop is usually taken at the cannery; (4) the purchase of containers is obviated; (5) there is more leeway in the time of picking; (6) larger areas may be planted and sold by the same amount of labor, as the market is nearby and several labor items are reduced.

Surplus crops of these vegetables are often sold to canneries even when they have not been grown under contract.

Home canning is sometimes resorted to by growers where community

canneries are not found. Home-canned products are not likely to meet the standard requirements of markets, and if they do the brand is not known and may not sell well on the market. Some growers, however, have established their own markets for canned products and have succeeded well with this plan.

Pruning and Trellising.*—Pruning and trellising are sometimes successfully practised in gardens. The advantages claimed for pruning and staking or trellising are: (1) larger fruit, (2) less disease injury, (3) earlier ripening of the fruit, (4) larger yields, (5) cleaner fruit, (6) greater convenience in harvesting, and (7) greater convenience in spraying the vines and fruit. The disadvantages that may be encountered are: (1) more labor and expense, (2) less total yield, (3) greater loss from blossom-end rot, (4) more sun scald of the fruit, and (5) more cracking.

A comparison indicates that convenience of harvesting and spraying is the only advantage gained by this method of culture. In experiments conducted at the Kansas Experiment Station the plants pruned and trellised showed greater injury from mosaic, more loss of fruit from sun scald and blossom-end rot, and increased cost of production. There is a possibility that by staking and pruning one may so increase the number of plants per acre that the decreased yield per plant may be overcome and the yield per acre increased. The cost of the plants is negligible, and that of the trellising would not be materially increased by this procedure. In general, under Kansas conditions, pruning and trellising are not advisable, though growers are successfully using this method.

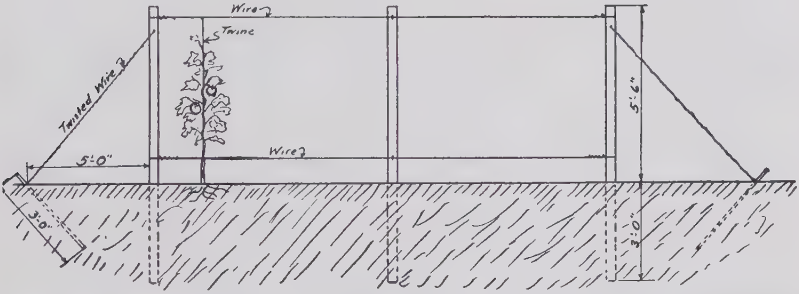


FIG. 171a.—Diagrammatic sketch representing a portion of trellis used on sections where the vines were pruned. (Kansas Experiment Station Circular 171.)

Staking.—In some parts the commercial tomato growers follow a different method of training the tomato vines from that practised in the station garden. Instead of the trellis described (Fig. 171a), each plant has a single

* Kansas Experiment Station Circular 171.

stake. The plants are trained to a single stem and are tied to the stake with a string or, in some cases, with a piece of rag. The tying should not be done in such a manner as to restrict the growth of the plant or to cut into the stem. The plants are usually trimmed once every week or ten days. Some growers pinch out the top of the plant when it reaches the top of the stake. This pinching out of the top of a tomato plant is said to hasten maturity of the fruit.

The stakes are usually 1 by 1 inch, though 1¼ by 1¼-inch material may be used. Willow saplings may be used when available. The stakes are usually 5 to 6 feet long and are driven into the ground 12 to 18 inches.

Average Cost of Producing an Acre of Tomatoes for the Cannery on 133 Farms in New York in 1920, and on 280, 205, and 205 acres in New Jersey.[1]

Item	New York, 1920		New Jersey (average), 1918–1920	
	Quantity	Cost	Quantity	Cost
Seed, ounces	....	......	2.4	$1.50
Plants, number	3,377	$21.98	1,173.14	2.08
Baskets, number	....	......	26.94	3.73
Cover crop, pounds	....	......	35.40	1.21
Fertilizer, pounds	602	13.35	884.42	17.50
Manure, tons	3	6.23	7.32	15.14
Lime, pounds	....	......	420.00	0.76
Spray material	....	......	....	0.84
Man labor, hours	164.7	68.77	125.99	40.45
Horse labor, hours	98.5	24.13	85.03	17.80
Use of equipment, hours	98.5	8.07	85.03	5.72
Use of tractor, hours	0.7	1.31	0.30	0.44
Use of truck or auto	....	0.46	2.86	4.20
Land rental	....	13.60	....	10.18
Miscellaneous expense	....	0.25	....	0.69
Interest on money, per cent	6	2.49	6	1.83
Cost per acre	....	164.59	....	124.06
Cost per ton sold	....	18.88	....	25.58
Yield per acre sold, tons	....	8.72	....	4.85
Yield grown per acre	Not estimated	......	....	5.19
Cost of harvesting, not including baskets, per ton	....	6.79	....	6.96

[1] From *Vegetable Crops* by H. C. Thompson. Published by McGraw-Hill Book Company, New York.

Job 12. Keeping Records

(See forms in apple enterprise.)

CHAPTER IX

MELON, CORN, BEAN, AND OKRA ENTERPRISES

Analysis into Jobs.—Crops of these four groups are of the warm summer season. Melons are often started in hotbeds in northern latitudes. Others are usually not started in hotbeds and are seldom if ever transplanted. They are all grown in home gardens and all are popular market crops. The melon group includes cantaloupes, watermelons, cucumbers, squash, and pumpkins. The corn includes sweet corn and popcorn only. The beans include snap beans, lima beans and other green shell beans. Okra is considered briefly in each job. The teaching units listed below include the operative and managerial jobs of these enterprises. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with one of these crops, 16MP.
2. Choosing the crop and the variety, 1634F, 232F.
3. Selecting soil and field; deciding acreage, 773.
4. Obtaining good seed; testing; treating, 156DC, 1341D, 1715F.
5. Preparing field for planting, 1394F, 1468F.
6. Planting the crops, 268C, 312T.
7. Cultivating.
8. Controlling enemies, 186T, 217DC, 326T, 1499F.
9. Harvesting, grading, and packing, 1250D.
10. Marketing and using, 74C, 425T, 1145F.
11. Keeping records, 511, 572, 782, 1182.

Job 1. Determining Possibilities with One of These Crops

Conditions Usually Found.—(1) Several of these crops are usually grown in home gardens. (2) The demand for these warm weather crops is found by commercial growers to be rather uniform year by year, and the growing is usually profitable.

Aims.—Students should consider the factors of cost, difficulties, advantages, yields, prices, and other factors involved in growing any of these crops.

Problems for Study and Discussion

1. In what localities and regions are these crops usually grown for market?
2. Find how many of these crops are grown in home gardens only.
3. In what jobs would the peak of labor come for each of these crops?
4. Ask commercial growers regarding the availability of labor for such jobs.
5. How much capital would be required for an acre of each of these crops?

6. From the money standpoint, what would be the returns of each of these crops per acre?
7. What uses could be made of the crops when grown?
8. In what markets could commercial crops be sold?
9. Under what conditions may extra prices be received for some of these crops?

Projects.—Students may well pursue vegetable projects for profit unless marketing conditions are very unfavorable. Improved methods of growing and marketing should be used.

Regions.—Cantaloupes, watermelons, and cucumbers are adapted to special regions and are not grown commercially everywhere. In the extreme northern tier of states few watermelons are grown. The commercial growing of cantaloupes has recently been extended from a few centers in California, Colorado, and near large marketing centers. The use of paper bands for transplanting plants from hotbeds has extended the growth much farther northward. Where there is a long or hot summer season the crops are more easily grown.

Cucumbers for slicing are commercially grown near large markets. They are also frequently shipped some distances. For pickling they are usually grown near pickling stations.

Roasting ears are abundantly grown for market in nearly all states. The intensive regions are usually near large market centers. This is also true of beans and to a less extent it is true of okra, which is more popular in central and southern latitudes.

Labor Involved.—When cantaloupes are transplanted for very early market, much labor is involved at transplanting time. When they are planted in the field, all of the vine crops have their peaks of labor in the harvesting season. Cucumbers require much labor in harvesting, and this period is extended over a large part of the growing season.

The labor for marketing corn is rather well distributed. Beans, like the vine crops, have the peak of labor in the harvesting season. Both the snap beans and the lima beans require an immense amount of labor for harvesting.

Capital Requirements.—Investments of money are required for seed, fertilizers, spray materials, and containers for marketing. If this enterprise is chosen, it is not difficult to estimate the amount of capital required per acre for each of these crops. After this is determined, the amount to be invested should be compared with the yields in dollars per acre.

Yields and Prices.—The following table gives an approximate idea of the yields to be expected per acre from the crops mentioned. These are averages for the whole United States for one year. The values per unit are shown.

Crop	Acres	Yields per Acre	Farm Value	Value per Acre
Cantaloupes	103,160	136 crates	$1.29 crate	$175
Watermelons	199,560	349 melons	$146 per car of 500	$102
Beans, snap	91,470	1.1 tons	$126 per ton	$139

Uses and Markets.—Markets should be considered closely before undertaking the growing of commercial areas of these crops. If facilities for marketing are available, the quantity which can be grown for that market should not be exceeded. Consider the problems of hauling to loading places, shipping, and selling in the markets.

Surplus crops of cucumbers may be brined or pickled when delivered to nearby factories. Cantaloupes and watermelons cannot be preserved for future use. Corn, and some types of beans, may be canned or dried for use or for sale at some future time. Okra is used in canned soups.

Job 2: Choosing the Crop and the Variety

Conditions Usually Found.—(1) Many more commercial growers are found for corn and beans than for the vine crops or for okra. (2) Commercial growers usually choose varieties and strains recommended by experiment stations to suit their particular markets and to resist disease. (3) For home use, those varieties are chosen which please the families. (4) For canneries and pickling plants varieties are recommended and seed supplied by companies concerned.

Aims.—(1) Growers should realize the importance of choosing crops and varieties carefully. (2) They should know what crops and varieties are best for commercial and for home use.

Problems for Study and Discussion

1. Inquire of local growers to see which of these crops are most popular in your region. Rank them in order of popularity.
2. Find if possible why some of these crops are so much more popular than others.
3. Why should commercial growers use the varieties found to be popular in the region?
4. What are the best commercial varieties for cantaloupes? For watermelons? For cucumbers?
5. What are the best commercial varieties for table corn?
6. What varieties of snap beans are most popular in your region?
7. Debate yellow snap vs. green snap varieties.
8. What types and varieties of limas are preferred for your region? Why?

Activities.—Make up a wall placard for each of these crops showing pictures of the varieties taken from a number of garden catalogues.

Which Crops to Grow.—In some regions cantaloupes are commercially much more profitable than either cucumbers or watermelons. Cantaloupes require a long warm season to develop 7 or 8 per cent of sugar. The growth of watermelons should seldom be attempted in northern regions except for home use or for local markets. The southern crop

easily supplies northern markets. Cucumbers may be produced with more profit where there is a local brining or pickling station to purchase the crop of the surplus. The location of canneries or pickling stations would largely govern the crops to be grown for their use. Corn and beans are so popular that their growth can be undertaken as profitable enterprises.

The grower's selection should be governed largely by the crops which are most popular in the region. It is usually unwise to attempt the commercial growing of crops which have not been found to be locally profitable.

Fig. 172.—Cantaloupes for the market should have abundant, deep netting with the ribs not prominent. Select seeds from such specimens. (North Carolina Department of Agriculture.)

Regional Varieties.—It is often bad policy for commercial growers to introduce new varieties of any trucking crops which the growers of the region are not all adopting, unless the products are for different purposes or go to different markets. Communities often find it advisable to grow a standard variety for market. Arrange with other growers so that all will work together in the choosing of varieties. Better choices will be made; markets will be better satisfied; buyers will be attracted to the region; there will be less trouble in procuring good seed; the saving of seed is easier.

The vine crops are in danger of mixing with each other, as varieties mix readily. Bees and other insects carry pollen from field to field. The bad effects are multiplied if seed is saved from such crosses. But the popular notion that cucumbers will cross with cantaloupes has been proven not true.

Simple methods of classifying varieties of muskmelons into a few groups or classes have been suggested by various workers. One method is based on color of flesh, separating varieties into groups: (1) those with green or white flesh and (2) those with salmon or yellowish flesh. This method is not of much value since separating the varieties into two groups is no great help in identification. Other methods of classification that have been suggested are based on size, shape, color, and smoothness of the surface—whether netted or not netted, ribbed or not ribbed.

In selecting varieties of muskmelons for market the grower should take into consideration the demands of the consumer, especially with reference to size of melon, color of flesh, quality, and surface markings. After determining the consumers' preferences he should consider varieties with reference to yield, disease resistance, earliness, shipping quality, keeping quality, and other factors that might affect profits. Some varieties of high quality are poor shippers and for that reason are adapted only for home use and for local markets. Others are excellent shippers, but of low quality. For long-distance shipping the varieties should possess good shipping qualities, such as a thick rind, relatively solid flesh, slow ripening, and uniform size and shape, but at the same time they should be of good quality.

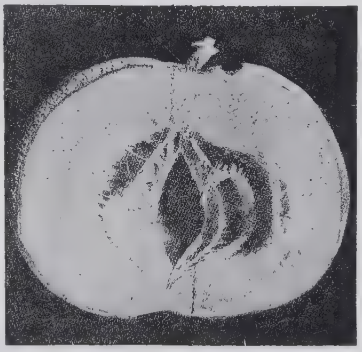


Fig. 173.—Large type of oblate muskmelon, with deep flesh, edible clear to the rind. (Vermont Station.)

Varieties.—There are very few varieties of cucumbers grown in the United States. The White Spine is the best known and most widely-grown variety. It is grown for all purposes, but is especially prized as a slicing cucumber. Davis Perfect is also a popular slicing cucumber. For pickling, Boston Pickling, Chicago Pickling, and Fordhook Pickling are considered valuable. For forcing the White Spine, crosses between this variety and the English forcing type are commonly used. One of these crosses, the Abundance, is a very popular forcing variety in some sections. The English forcing varieties are not very popular in this country.

Corn.—Sweet corn varieties are usually classed as early, medium, and late. This really refers to the number of days needed to produce edible ears. They are also divided into yellow and white; this of course refers to the color of the kernels. Local tastes, growing conditions, and markets determine the varieties to grow. Where possible those resistant to Stewart's disease should be grown.

Types and Varieties of Beans.—There are several types of bean produced for market. Those in pods, called "string beans," are gathered

FIG. 174.—A Florida field of cucumbers with overhead irrigation. (Florida Station.)

before maturity and sold and used in the green or yellow tender pods (Fig. 175). Shelled or fresh beans, sold without maturing the seed, are

FIG. 175.—Early stringless wax beans, variety Wardwell's. (Cornell Reading Circle Leaflet.)

a type represented by limas. A third type of bean for market is the mature dried bean, found in several types.

Among "string" or "snap" beans, popular varieties are Valentine,

Kentucky Wonder, Stringless Green Pod, Brittle Wax. Refugee is extensively used by commercial canners. Green shelled beans are chiefly represented by the limas but several other forms of green shell beans

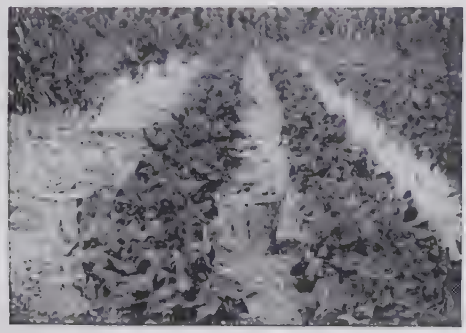


FIG. 176.—Bush limas are less productive than pole limas, but they mature their crop in less time and labor of staking is saved. (New Jersey Station.)

are grown in some regions. There are three types of limas. These differ in size and shape of seed. The largest lima beans are very large when full grown and are shelled before they turn to a yellowish color. They

FIG. 177.—Okra or "gumbo" is much grown in the South and used in soups, for stewing, and for pickling. (*Productive Vegetable Growing.*)

are among the most common limas in central and southern regions. A very popular variety is King of the Garden. The type is rather sensitive to changes of temperature during the summer. If the soil becomes cold

and clammy, it does not thrive well, and is therefore more difficult to grow in northern regions than the smaller kinds. It demands a richer soil and more careful attention.

Potato limas are so called from the shape of the seed. They are intermediate in size between the large limas and the Sieva type, which is very small. The Sieva limas are probably the easiest of all to grow and succeed well under rather poor management and in the hands of inexperienced growers. Bush limas of this type are preferable in northern regions. They are represented by Henderson's and Burpee's Bush Lima. All three of these types of beans are found both in the pole or climbing and in the bush varieties (Fig. 176). Garden catalogs should be consulted for a choice of good varieties for your region. Pole varieties are always more productive than the bush varieties but do not stand drought and poor soil as well as the bush varieties. In home gardens bush varieties are more likely to be found than others.

Okra.—Good varieties of okra should produce continuously and the pods should not be too large (Fig. 177). Good market varieties are Clemson and Long White Velvet.

Job 3. Selecting Soil and Field; Deciding Acreage

Conditions Usually Found.—(1) Soils not well suited to some of these crops are too often used for them; this is particularly true of melons. (2) Experienced growers usually understand how to choose suitable soils and good rotations, and plant fields of such sizes as can be properly managed and well marketed.

Aims.—What soils are best for each of these crops, how to plan rotations, and how large a crop to grow should be fully considered.

Problems for Study and Discussion

1. What local soils are considered best for cantaloupes, cucumbers, and watermelons?
2. Which would be most productive for early corn? For late corn? For early beans? For late beans?
3. Plan a good rotation to suit your farm for the vine crop. For corn and beans.
4. Ask growers whether they would increase or decrease the sizes of their fields for these crops this year.
5. How can you improve soils which seem too heavy for early market crops?
6. If soils you need to use for these crops are likely to suffer for moisture in hot, dry weather, how could you improve them?

Soils for Early Market Crops.—Very light, well drained, sandy loam is preferable for all of these crops if they are grown for early market. Watermelons require lighter soils than the others for successful growth. Growers believe more humus is required in the soil for cantaloupes and cucumbers than for watermelons. Corn and okra thrive best on soils rich in organic matter. Beans will thrive on a variety of soils. Rich, black, sandy loams will give good returns.

Drouthy Soils.—All of these crops are liable to suffer for want of

moisture in hot, dry weather. Very sandy soils, or any that are deficient in organic matter, are most likely to allow crops to suffer from drouth. Adding organic matter by turning under a good green-manure crop or by plowing in a heavy application of barnyard manure will aid greatly in holding moisture in the soil for continuous growth of the crops.

Rotations.—These crops should seldom be planted on the same field twice in succession. Fungous diseases and insects are much worse in such cases. Try to have a grass sod crop or a clover crop precede these crops to lessen the danger from disease-causing organisms and insects. One of these crops may be planted as the first cultivated crop after the usual four-year rotation of the central and northern states. The rotation may be grain or corn, clover, grass, truck crop. Grain would seldom be used on soils well suited to melons and cucumbers.

Acreage.—Truck farmers should be cautious regarding the increase of acreage with these perishable crops. Grow areas small enough to be properly cultivated and sprayed. If pickling stations or canning factories are located in the region, the areas for crops to be sold there may be much larger than if the markets for fresh products must be depended upon.

Job 4. Obtaining Good Seed; Testing; Treating

Conditions Usually Found.—(1) A nearby grocery store is too often the source of seeds for these crops. (2) A few growers save seeds at home; others obtain good seed by buying from reliable seedsmen.

Aims.—(1) The dangers of obtaining impure seed of the vine crops and corn through crossing should be understood. (2) Methods of producing good seed at home and of buying best seed should be known. (3) How to test and treat seed should be learned.

Problems for Study and Discussion

1. Ascertain how many local growers obtain seeds in each of the three ways mentioned above.
2. Find their reasons for these methods.
3. Draw conclusions as to the best methods of obtaining seeds for each of these crops.
4. What is meant by strains or varieties resistant to disease?
5. Under what conditions will the vine crops cross with each other?
6. Under what conditions will different varieties of corn cross?
7. Debate home production of seed vs. buying from dealers.
8. Give directions for producing pure seed for sale to others.
9. What is meant by rogueing of plants?
10. How could you select seeds of melons resistant to wilt?

Activities.—(1) Practise selecting for seed cantaloupes resistant to wilt, of good type in every way, and not cross-pollinated with inferior types. (2) Pursue a project in the production of rogued cantaloupe seed for market.

Buying Good Seed.—Reliable seedsmen can usually supply good seeds of each of these crops. The vine crops cross-pollinate by insects. The varieties of corn cross-pollinate by wind. Purity of seed is therefore

endangered when crops which will cross are grown too close together. Good seedsmen obtain each variety of seed under conditions which will prevent crossing. Sometimes bad lots of seed are obtained through the commercial channels. Obtain names of reliable seedsmen from experiment stations and from experienced growers. Varieties not true to name are most common among cantaloupes. Sweet corn grown near field corn is likely to show the effects of crossing the first year and should not be saved for seed if crossing has occurred.

Saving Seed at Home.—Truck growers having one variety only may safely save seed from typical plants if no other crops are near enough to contaminate them. If disease-resistant strains are grown, seed saved from these may also be resistant to disease if no crossing has occurred. Growers should choose seed from melons or cucumbers that are true to type in their size, shape, color of flesh, and markings. As very little seed is required for the vine crops and for corn or okra, truck farmers should realize the importance of procuring the best seed for these crops. There is less trouble in obtaining good seed for the bean crops, as they do not cross-pollinate to any considerable extent.

Certified Seed.—Growers may produce seed for sale to others. Students or other farmers may produce certified seed by having the field inspected after it has been thoroughly rogued. A seed breeders' association for the state may send an expert to the field to examine and certify to the conditions found. Standard seed must be produced if a certificate is to be granted. Many growers sell pure seed to reliable seedsmen, growing the crop under contract for this purpose. Seed, to be standard, must meet the requirements of the association regarding purity, freedom from cross-pollinating, trueness to type, percentage of true plants in the field, and other factors.

The term "pedigreed seed" is often loosely used, meaning that the strain or variety of seed has been kept pure without outside crossing. When this term is used in the best sense, it is intended to mean about the same as certified seed or good pure seed.

Testing Seed.—When seed is old, the germination is likely to be very low. This is less true of the vine crops. Testing by some simple method is important and is one of the best ways of detecting lots of old seed. The expense is slight. Corn should invariably be tested. (See methods of testing in the tomato enterprise.)

Soaking Seeds.—It often helps to soak seeds of the vine crops, and perhaps corn, before planting, but many successful growers fail to soak seed. There is danger in soaking beans before planting, as the large seed leaves are likely to slip apart when handled after soaking. Soaking melon and cucumber seeds for twelve hours hastens the germination and reduces

the danger of the seed being eaten by enemies in the soil. The hot water or chemical treatments against diseases would take the place of other soaking.

Treating Seed.—Experiment stations have shown the advantages of treating corn, bean, melon, and cucumber seed before planting to kill spores and prevent the introduction of disease into the soil. Mercuric chloride is used for treating seed potatoes and vegetable and flower seed.

Seed potatoes may be soaked as long as ninety minutes and never less than thirty. Vegetable seeds are treated five minutes with the exception of the cole crops which are treated thirty minutes. Except for potatoes, rinse the seed in clean water and sow as soon as dry enough to go through a planter drill.

Field mice and ground squirrels often eat new-planted melon seeds. The seeds may be poisoned by treating with strychnine, using one-eighth ounce to a quart of warm water. This should be done just before planting. A little sugar added to the poison will make the work more effective.

Job 5. Preparing Field for Planting

Conditions Usually Found.—(1) Home gardens are often poorly prepared and poorly fertilized. (2) Truck growers using expensive land are usually more thorough in preparing soils for these crops.

Aims.—Beginners should learn to do this work intelligently and economically.

Problems for Study and Discussion

1. Study methods of local growers who prepare soils well for these truck crops.
2. How is organic matter supplied?
3. Do local growers prefer barnyard manure or green manure? Why?
4. Ascertain how many growers apply commercial fertilizer before planting the crops.
5. What commercial fertilizers are most commonly used?
6. What is meant by a bare-fallow period before planting?
7. Discuss depth of plowing for these summer crops.
8. What implements should be used to prepare the soil before planting these crops?

A Good Seed Bed.—As the planting season is later than for many other truck crops, spring plowing is usually practised. This plan allows the plowing under of a winter cover crop as green manure. This method of obtaining organic matter for the soil is cheaper than the purchase of barnyard manure. If the farm has a supply of barnyard manure, it can be used on these crops to very good advantage. All of these crops respond rather well to manure and need a great deal of plant food in the soil. The organic matter should be partially rotted, but need not be so thoroughly rotted as for some other truck crops, such as onions.

A Plan Outlined.—Plow the ground rather early in the spring and as deep as the surface soil will allow, and then harrow it several times to keep a bare fallow until planting time. It may need disking if the soil becomes

packed or if there is much litter or sod to be worked into the soil (Fig. 178). This method is called bare fallow before planting. It destroys weed seed in the soil, warms the soil rapidly, and should produce a quick, rapid growth of crops when planted. To facilitate planting, the surface may be planked just before marking off the rows.

Fertilizers.—For market crops it is often wise to use commercial fertilizers on soils not supplied with plenty of plant food and organic matter. If enough barnyard manure has been used, this may not be

Fig. 178.—When the soil for a new garden is first plowed the prospect for a good garden may be very discouraging. The clods may be crushed by a planker drag or an acme harrow. This should be done immediately after plowing, before the clods become hard.

necessary. Fertilizer may be applied in a formula 5–8–5 (N–P–K) at the rate of three hundred to one thousand pounds per acre. It is a good plan to use such a mixture at planting time or just before. Do not allow the fertilizer to come in contact with seed, as it retards germination. For melons and cucumbers, add one hundred pounds of nitrate of soda per acre when the plants begin to run a little. This may be used as a side dressing one foot from each hill.

Job 6. Planting the Crops

Conditions Usually Found.—(1) Poor methods of planting are often practised by beginners. (2) Experienced commercial growers seldom make mistakes in planting.

Aims.—The time, depth, manner, and rate or distance of planting should be understood.

Problems for Study and Discussion

1. What is the best time for planting early varieties of each of these crops?
2. Why should soils be warm before planting?

3. How would you mark off the rows for vine crops? For corn? For beans? For okra?
4. At what depth should seeds be covered for each of these crops?
5. Give suitable distances for planting watermelons, cantaloupes, and cucumbers.
6. Give suitable distances for planting garden corn.
7. Why would you plant the small, early varieties closer together than the late varieties?
8. Give suitable distances and rates of planting for snap beans and lima beans.
9. How would the pole-bean crops differ in rate of planting from the bush varieties?
10. Compare hill with drill methods for planting beans, corn, and okra.
11. Why should more seed be used in planting vine crops than you intend to have grow in the field?
12. Describe a method of manuring the hills for melons at planting time.
13. Discuss the forcing system for producing early cantaloupes.

Activities.—(1) Test improved methods of planting by comparing with common or less valuable methods. (2) Test the value of applying rotted manure in the hills of cantaloupes; this may be compared with the use of commercial fertilizer.

Warm Soils.—For the tender crops the soil should be warm. It may be hastened by fallow which also lessens the cultivating needed later. Growth

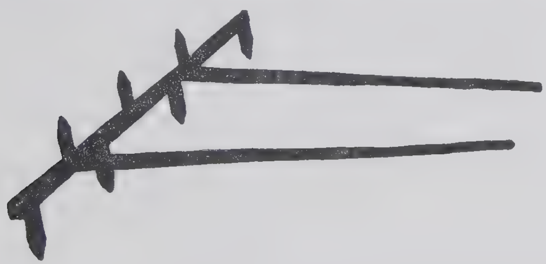


FIG. 179.—A simple marker for garden rows, to be drawn by hand. Marks two widths of rows.

should not be checked by cold soils or cold weather. Crops will be earlier if continous rapid growth follows planting. Corn for early market is often planted in time to be sprouted as soon as the last spring frost is over. If plants are killed replanting is quickly done.

Marking Rows.—For corn and okra, common field markers are used (Fig. 179). Rows for beans may be marked with a bulltongue plow or with a deep marker. The seed may then be drilled or dropped in hills as desired. Drilling is usually preferred to hilling for corn, beans, and okra.

For melons and cucumbers, a field marker with the runners spaced very wide may be used. Suitable distances between hills for watermelons are six to eight feet each way. For cantaloupes and cucumbers, the distances are one or two feet less each way. Corn, okra, and beans are planted in drill rows which are about two and one-half to three and one-half feet apart.

The depth of covering should be very slight for melons, about one-half inch; for beans, corn, and okra, the depth may be one or two inches, according to the texture of and moisture in the soil.

Planting.—Watermelons, cantaloupes, and cucumbers should be planted in level hills with a fork full of manure in the bottom of the hill. Ten to fifteen seeds are scattered in this hill and covered slightly with a hoe. After germination takes place and the third and fourth leaves have formed, the number of plants may be thinned to about two or three in each hill. The reason for extra planting is to allow for destruction of seeds by mice or the killing of plants by cucumber beetles.

Pole and Snap Beans.—Pole beans are often spaced more widely than the bush beans, but with some varieties the opposite of this is true. Pole beans produce over a longer period than bush beans and for that reason need a little more room. Some bush beans branch more than pole beans, and the bushy varieties should be given enough space. If seeds are drilled at distances of four to six inches, the plants may be thinned by removing half of the plants if a full stand is obtained.

Forcing Early Cantaloupes.—Seeds of cantaloupes are sometimes started in hotbeds or cold frames in order to get an extra early crop for market. They should be planted three or four weeks earlier than they would be out of doors. The crop is proportionally earlier. This method is more popular in the north than in the south. When this method is followed, protection from striped cucumber beetles is much easier. The labor of transplanting and the cost of beds and sash are the chief objections but the better returns often make this up.

Soil bands, holding about a pint of soil, are used. The seeds are planted in these bands after they are put in the beds. This plan allows the melons to be transplanted to the open field when the weather is warm without disturbing the roots. Sometimes inverted sods are used instead of soil bands. This saves a little expense for the bands but does not reduce the labor.

As the bands have no bottoms, the young plants are handled on a broad flat shovel or in wooden flats. These are carried to the field in wagons or trucks and handled in like manner again as the rows are planted. Strong plants should be produced in four weeks from planting time, but transplanting should not take place until the night temperature is nearly 55 or 60 degrees F. out of doors.

Job 7. Cultivating

Conditions Usually Found.—(1) Cultivation is likely to become a laborious hand job instead of a horse job in home gardens. (2) In commercial fields, cultivation is more systematic and is accomplished more economically.

Aims.—(1) Students should learn the most economical ways of cultivating. (2) They should understand the purposes and learn how best to attain them.

Problems for Study and Discussion

1. Ask growers what cultivating implements are used for these crops.
2. How soon after germination should cultivation begin?
3. What depth of cultivation near the rows should be practised?
4. How frequent and how many cultivations are required for each of these crops?
5. When should cultivation cease for the vine crops?
6. What arguments may be given for and against moving the melon and cucumber vines to one side for late cultivation?
7. Give reasons why weed growth should be thoroughly controlled.
8. Debate weed control vs. moisture control.
9. Why is horse cultivation more economical than hand work?

Activities.—Conduct trials to show whether to continue cultivating melons after the vines have spread. Methods of handling the vines should be compared.

Early Tillage.—Sometimes the soil becomes crusted or baked by heavy rains before seeds germinate. It may pay to scratch the surface with a garden rake to assist germination. This is more important for melons and cucumbers than for the other crops. At this time the hills may be cleared of weeds which would otherwise grow ahead of the crops. Early tillage is important in all cases. Work the soil between the rows with a harrow or with a spike-tooth cultivator as close to the rows as possible. The first tillage may be rather shallow to avoid moving much soil toward the plants. All the space between the rows should be kept thoroughly pulverized to prevent the growth of weeds even before they are large enough to show.

Late Cultivation.—After the use of spike-tooth implements, later cultivation may be given with shovel or spring-tooth cultivators. Sometimes a disk harrow is used once between rows for melons or cucumbers.

Some growers find it profitable to move the vines of cucumbers and melons to one side for the last cultivation which should be shallow. Moving vines requires much hand work and usually is not necessary if good cultivation is maintained before the ground is covered with the vines.

Killing Weeds and Saving Moisture.—Experiments have shown that killing of weeds is fully ninety per cent of the problem of cultivation. The saving of moisture which might evaporate through the soil is much less important, but the grower must remember that when he controls weeds he is saving much moisture. Weed growth would rob the soil of plant food and moisture which the crop should use.

Suckering Corn.—Some varieties of corn produce suckers, which should not be removed.

Pollination of Melons and Cucumbers.—Two kinds of flowers are borne by each of these vine crops. For the production of fruit, pollen is borne from flower to flower by insects. Honey bees are most active for

this work. Growers often find it profitable to locate hives of bees near their fields of melons and cucumbers.

Job 8. Controlling Enemies

Conditions Usually Found.—(1) Several of these crops are seriously affected with insects and diseases which must be controlled. (2) Good methods of controlling them are available and are used by the best growers.

Aims.—The nature of these enemies, their injuries, and methods of control should be well understood by beginners.

Problems for Study and Discussion

1. What insects are most injurious to melons and cucumbers in your region?
2. How do growers control cucumber beetles?
3. Review the enemies of corn mentioned in field-crop books.
4. What are the chief insects attacking beans?

FIG. 180.—Three-row duster operated by gas engine; used on melons to combat striped beetles. (New Jersey Station.)

5. Give methods of controlling these.
6. What diseases affect the melon and cucumber crops?
7. Describe methods of preventing these diseases.
8. What are the worst diseases of beans? How are they controlled?

Activities.—(1) The value of spraying the vine crops with Bordeaux mixture may be tested. (2) Practise both spraying and dusting for cucumber beetles and decide which is more economical and successful in control.

Striped Cucumber Beetles.—These are small active beetles which come in great numbers about the hills of melons and cucumbers. The beetles eat the leaves, attack stems of young plants, and often ruin the plants. Work begins early and most of the damage is done before the plants send out long runners. Apparently these beetles are carriers of some of the virus or mosaic diseases and also of some of the fungous dis-

cases of melons, and if for that reason alone rigid control is desirable. Most growers recognize these beetles readily. They are striped with yellow and black and are less than one-fourth inch long.

Control.—Poisoning is rather difficult but is very satisfactory. Use one pound of lead arsenate in fifty gallons of Bordeaux mixture. Spray the young plants as soon as the beetles appear. Repeat about every week or two, depending upon the rainfall and growth.

Dusting is sometimes preferred (Fig. 180). For this use one pound of arsenate of lead powder in five or six pounds of lime dust (Fig. 181). Some growers add to the dust mixture a repellant such as turpentine,

Fig. 181.—Dusting cucumbers and melons with cheese-cloth bag for control of the striped cucumber beetle. (United States Bureau Enterprises.)

carbolic acid or tobacco dust. Nicotine may be used as contact dust to kill the beetles.

Melon lice or aphids have a peculiar life history and multiply very rapidly. Attacks should be watched closely before the lice become numerous. They cluster in great numbers on the under sides of the leaves and young stems. Leaves are curled, stems shortened, and plants dwarfed. Vines are often ruined by lice. They suck the juice of the plant and cannot be poisoned.

Control.—The most common remedy is to cover the plants thoroughly with tobacco dust or to spray thoroughly with tobacco extract known as nicotine sulfate. The latter should be diluted with a thousand parts of water. As the lice are on both sides of the leaves and on the stems, the dust or spray should be applied under the leaves and the top. Lifting the vines by hand is sometimes necessary. If the vines are handled at the

time of the last cultivation by throwing them in windrows, spraying or dusting may be done at the same time. Aphids are sometimes held in check by promptly pulling and destroying the occasional infested plants as the insects are found.

Squash Bugs.—Adults live in rubbish over winter and lay eggs on the under sides of leaves of young plants of the melon group. The numerous young insects attack the plants, puncturing leaves and stems and sucking the sap until leaves wilt and die.

Control.—Burning or turning under trash in the fall, collecting adults in traps in early spring, and spraying or dusting young insects on the plants with nicotine sulfate, are suitable methods of control.

Vine Borers.—These moth larvæ prefer to bore in squash and pumpkin stems but also attack melons and cucumbers. They start work near the ground line of the plant and tunnel in the main stems, causing vines to wilt and die.

Control.—Squash vines may be grown as trap crops and these may be destroyed when infested. Cut out borers by running a knife blade lengthwise of the stem when wilting begins. Vines may then be covered with soil two or three feet from the central root. This will cause roots to be formed which may save some of the vines. Old vines should always be burned or plowed under to some depth. Crop rotation may aid somewhat.

Corn Earworm.—This insect is the larva of a night-flying moth, and is familiar to all who have noticed them when husking ears of green corn. The larvæ attack not only green corn, but cotton bolls, fruit of tomatoes, buds of tobacco plants, melon crops, and other vegetables. They not only injure ears of corn by eating them but also cause decay to follow.

Control.—Dusting corn with arsenate lead when first in silk is a difficult means of partial control. Along the margins of the field a few rows of corn may be planted and grown as a trap crop very early and in rapid succession. This may be cut and fed to livestock at the proper time to destroy the insects.

European Corn Borer.—This terrible enemy of corn has come through Canada into the northern States and is moving southward. The larvæ are caterpillars of night-flying moths. They bore into the stems and ears of corn and devastate the crop. They attack sorghum, millet, and many flowers, vegetables, and weeds.

Control is very difficult. Complete feeding of the corn plants to livestock each year is one of the best practices to follow. The crop may be cut at the ground and made into silage or cut up or shredded so live-

stock will eat the entire product. Plow under stubble and stalks very completely, preferably in the fall. Burn weeds and rubbish near all fields in winter.

Melon Worms.—These are also called cucumber worms. They are more common in central and southern regions than in the northern states and Canada. The adult moths are white, marked with brown borders on the wings. Most damage is done by the second and later broods each year, when the larvæ feed on the melons and cucumbers, boring into the rinds and flesh. Fruits are ruined for market purposes.

Control is very difficult. Spraying and dusting with poison, as for striped beetles, will destroy the greater part of the early brood and reduce later injury. Trap crops of squash may be planted ahead of the melons. The vines should be completely plowed under very early in the fall.

Melon Diseases.—Several diseases attack melons and cucumbers, such as rust and wilt. Vines may wilt and die. Some of these attacks may be recognized by small brown spots on the leaves. These enlarge and run together until the whole leaves and vines turn brown. Attacks usually occur at the hill and spread outward.

Control.—If Bordeaux mixture is used with the poison when fighting striped beetles, the spray will largely control these diseases also (Fig. 180). The spraying should continue until nearly ripening time at intervals of a week or ten days. If the Bordeaux mixture does not entirely control the diseases, it will probably retard attacks enough to allow the crop to mature as it will lengthen the life of the leaves.

Disease-resistant varieties and strains of melons may be used where necessary. Crop rotation and treatment of seed are very important control measures. Treat seed with corrosive sublimate. (See Appendix.)

Bean weevils, which often attack beans, have become very serious in some sections, particularly in the central and southern latitudes. The chief remedy against this enemy is to spray or dust thoroughly with an arsenate of lead mixture. About five parts of lime with one part of arsenate of lead, applied as a dust, will control bean weevil very well. If snap beans are dusted in this way, it is necessary that the pods should be washed before marketing or using, for the poison is dangerous on the table for human use.

The white fly is a very serious enemy of beans. The best remedy is to spray with nicotine sulfate as described for plant lice.

Anthracnose and other serious diseases are sometimes found. Spraying with Bordeaux mixture is a rather certain remedy if applied in time.

Job 9. Harvesting, Grading, and Packing

Conditions Usually Found.—(1) Methods of harvesting vary according to the season, the market requirements, and the variety. (2) Experienced growers seldom make serious mistakes in harvesting these crops. (3) They more frequently make mistakes by grading and packing poorly. (4) Harvesting crops too soon when prices are high is a temptation to which some growers yield.

Aims.—(1) Beginners should understand the best time and methods of harvesting early and late varieties of these crops. (2) They should study market requirements for grading and packing. (3) The best methods of handling for market should be understood.

Problems for Study and Discussion

1. Which of these crops have the widest range of marketing time? Which least?
2. Show the relation between early harvesting and prices received.
3. Ask growers to describe the stage of maturity or growth for marketing each of these crops.
4. What rules would you follow in grading cantaloupes and cucumbers?
5. Tell how to pack watermelons in a car.
6. What containers would you use in shipping cantaloupes, cucumbers, corn, and okra to market?

Activities.—(1) Make up suitable containers for packing each of these crops, using the materials manufactured for these purposes. (2) Contests should be conducted to develop skill in judging maturity, harvesting, grading, and packing.

Range of Picking Time.—There is a little more range of harvesting time for watermelons, cantaloupes, and cucumbers than for table corn, snap beans, and okra. Lima beans allow a little more time than other beans. The grower must watch the maturity and growth of these crops carefully if the best returns are to be attained. Overgrowth or underripeness are undesirable. Corn, if too ripe or too young, will be rejected on the markets. Cucumbers are usually harvested according to size desired, but for some markets the slicing cucumbers must be full grown and not quite ready to color. The maturity of watermelons is judged by the curl, as well as by the firmness or sound when thumped. Watermelons and cantaloupes to be shipped long distances must be harvested before they are dead ripe. The proper maturity of cantaloupes may be better judged if pickers cut open a few fruits and then judge by color, netting, pressure or firmness, and readiness in separating from the stem. Snap beans are usually harvested as early as the size of the pods will warrant. The different types of limas are harvested according to the size of the beans within the pods.

Growers are tempted to pick products too soon, particularly in the first of each season when prices are highest. This is likely to ruin the market for the best products, as some buyers are unable to judge maturity for themselves and when once fooled refuse to buy at all.

Grading.—Cantaloupes are graded according to the depth and abundance of netting of the surface and the depth of ribbing. Those of uni-

form size should be packed together. If a difference in color is apparent those of uniform color should go together.

Cucumbers are graded according to size, shape, and maturity.

Corn is graded according to the size of ear, and only one color should ever be marketed in the same lot.

Snap beans are graded by type, color, and variety. Maturity may also be considered. Okra pods should be graded according to maturity, size, color, and shape. Each lot should be uniform.

Containers.—Watermelons are usually packed in box cars without crates. The melons should be placed in cars with one pole toward the front of the car. This prevents rolling when cars are starting and stopping. About three or four layers of melons are placed in a car when loaded. Each layer should be as snug as it is possible to place it, to prevent movement in transit.

Cantaloupes are packed in open crates, varying in size in different regions. The number of cantaloupes in a crate is stamped on the end. Smaller crates are usually used for early shipments which may be sent by express.

Cucumbers for slicing are often shipped in Georgia crates holding six one-gallon baskets.

Corn, when shipped to market, usually goes in crates similar to those used for cantaloupes, but the crate is usually flat to accommodate the length of the ears, as the ears stand on end in the crate. For short hauls, roasting ears are commonly delivered to dealers in gunny sacks or hauled in wagon beds for open-air markets. It is a popular custom to cut the husk away at a point near the middle on one side of each ear to reveal the stage of development of the kernels to the dealer and buyer.

For most markets, snap beans and lima beans are marketed in gallon baskets which are packed six in a crate. Snap beans are also shipped in bushel hampers. For the very early crop, quart baskets are sometimes used. In a few special markets, lima beans are shelled before marketing. In such cases the crop usually goes to market in quart boxes packed twenty-four in a crate.

Okra with small pods is usually marketed in quart boxes or gallon baskets packed in crates. The larger varieties are usually packed in baskets holding a half bushel or more.

Job 10. Marketing and Using

Conditions Usually Found.—(1) Shiftless methods of marketing are too often found in small markets. (2) In the competition for early high prices immature products are often marketed. (3) Improved methods of marketing are more popular than formerly.

Aims.—(1) Beginners should study the marketing problems for each of these crops. (2) The best methods of marketing should be understood.

Problems for Study and Discussion

1. Discuss with growers the best methods of marketing watermelons.
2. What means of transportation are most available for marketing these crops from your region?
3. Discuss shipping by truck and by rail.
4. What special methods of marketing any of these crops are found in your region which are not used elsewhere?
5. Which of these crops do you consider most injured by long delays in marketing?
6. Which must be freshest on the market?
7. Review the dangers of overstocking markets, discussed in the tomato enterprise.
8. Enumerate advantages of coöperative selling of these crops.

FIG. 182.—Coöperative grading of school garden vegetables.

9. What uses may be made of some of these crops when the markets for fresh products are satisfied?

Activities.—Skill in loading and marketing in different ways should be attained through practise, and contests should be planned.

Steps in Marketing.—For products such as cantaloupes, which may be marketed in carload lots, the steps in marketing, after harvesting, grading, and packing are completed, may be enumerated as follows: (1) ordering and placing cars; (2) precooling and icing cars; (3) loading truck into cars; (4) re-icing if necessary; (5) billing; (6) diverting shipments if markets are found to be crowded; (7) wiring consignees of shipment.

Truck vs. Rail.—Many growers use trucks for shipments even for distances of more than one hundred miles. They find this requires less handling. Movements may be made at night, with little need of ice.

Bills for unloading at destination are eliminated. The truck driver may be a good representative of the shipper in markets. Less deception on the part of city handlers is possible. In some cases the cost of shipment is less. Products reach markets in a fresher condition.

Freshness and Delays.—Watermelons, cantaloupes, and cucumbers can stand longer delays in shipment and in marketing without ruining the product for market purposes than the other crops in this group. Corn, snap beans, and okra require marketing in a very fresh condition.

Using Surplus Products.—Where pickling factories and canneries are located, surplus cucumbers, corn, beans, and okra may be sold. This seldom benefits market gardeners who grow products for city markets. But for truck farmers this condition often saves dumping surplus products on markets and ruining the prices received for fresh products. See Job 1.

Neighborhood Markets.—Surplus products from home gardens are sometimes sold in special, open-air markets. Competition is keen, and farmers sometimes become very good salesmen.

Squash

There are two main types of squash, the bush and the running variety. Much more space is required for the running varieties. In selecting seed from the catalog note carefully which type is chosen. The running varieties are more popular except in small gardens.

In the matter of season, there are two types. The summer squash is harvested green during the summer season. Popular varieties of this type are White Blush and Acorn. The winter squash forms a hard rind when mature. Popular varieties are Delicious, Hubbard, and Boston Marrow. Cushaw is one of the crooknecks. The winter squash may be stored in cellars until midwinter. In harvesting for storage they should be very ripe with firm rind, and should be handled carefully.

Prepare the soil as thoroughly as possible. Plant the bush varieties in places about four or five feet apart each way. The running varieties should have space of about eight or ten feet each way. Two or three plants may be left in each place. The crop grows best in hot weather, and will not endure frost. Plant two or three weeks after earliest corn-planting time. The crop is sometimes grown in rows of corn, as the plants will endure shade almost as well as do pumpkins. If the crop is grown with sweet corn of the early or medium varieties, the corn stalks may be cut as fast as the roasting ears are removed. The squash vines then have the entire area. After the summer-squash crop is harvested the vines may be removed and late corn crops may be planted.

Pumpkins

Culture.—There are two main types of pumpkin, grown chiefly in corn fields. The small pie pumpkin is sweeter than the large field pumpkin, the latter being used chiefly for stock. The pumpkin endures shade well and thrives well in growing fields of corn. The seeds may be planted in every third row of the corn field and are covered about one inch deep. Two or three seeds are planted in each hill. This is done in the South after the corn is about ready to tassel, or in northern regions, when the corn is well started. The corn cultivation may be over by the time the pumpkin vines begin to run. The crop is often harvested after the corn is cut. This may be done either by hauling in the crop after frost or by turning stock into the field.

Diseases and Insects.—Pumpkins are not seriously injured by diseases nor attacked by insects. However, downy mildew, bacterial wilt, and anthracnose do cause considerable difficulty some years. The control of these diseases, which attack the other cucurbits including the cucumber, watermelon, and cantaloupe, is described in U. S. D. A. Farmers' Bulletins 1394 and 1468 and Circular 217.

The important insects are aphids, squash vine borer, and the squash bug. For their control see Farmers' Bulletins 1499 and 1371.

Storing.—Pumpkins and squash may be kept several months if they are well matured, free from insect and disease injury, and stored in a dry room at about 60° F. for about two weeks and then at 45° to 50° until used.

Job 11. Keeping Records

(See forms in apple enterprise.)

CHAPTER X

ONION-GROUP ENTERPRISES

Analysis into Jobs.—Enterprises with onions, garlic, leeks, and chives may well be studied under the following list of practical jobs, which include both the operative and the managerial aspects of the business. References are to U. S. Farmers' Bulletins. See also U. S. D. A. Yearbook, *Statistics of Fruits and Vegetables.*

1. Determining possibilities with these crops, 354.
2. Choosing the type and variety, 354, 434.
3. Selecting soil and field; deciding acreage, 354.
4. Providing organic matter, 1142, 1250.
5. Obtaining good seed; testing; treating; obtaining sets, 434, 1390.
6. Buying, and mixing fertilizers, 706, 185C, 1280D.
7. Preparing soil for planting, 354.
8. Planting and fertilizing, 399C.
9. Thinning, weeding, and cultivating the crop, 354.
10. Controlling enemies, 1007, 1060, 1371.
11. Harvesting, curing, and grading.
12. Storing the crop, 879.
13. Marketing, 1144, 1551.
14. Keeping accounts, 511, 572, 782, 1182.

Job 1. Determining Possibilities with these Crops

Onion Climates.—The onion is one of the most important truck crops of the country. The ripe onion crop is well adapted to central and northern latitudes. It thrives well in cool moist spring weather, and the dry weather of mid-summer is favorable for maturing, harvesting, and curing the crop.

Green onions sold as bunch onions in the market are grown in both fall and spring, but chiefly in the spring.

Production and Profits.—The average yield per acre for the ripe onion crop is 276 bushels for the whole United States. In regions where the crop is grown intensively the average is often nearly double this amount.

Prices vary considerably for both the early green crop and for onions stored until winter. Prices are low in some years when the production is unusually great.

Capital and Labor.—The capital requirements for onions are no greater than for most other truck crops. The greatest amount of labor occurs at harvesting and curing time. Topping is often done by hand and much labor is involved. Another high peak for labor occurs when the crop is being thinned or weeded by hand.

Job 2. Choosing the Type and Variety

Onion Types.—Onions are referred to as green-bunch, and ripe. The ripe onions are of two main types, the American and the foreign. The latter is represented by the Bermuda type, which is grown mainly in Texas and somewhat in other Gulf states, it is milder than any of the other

Fig. 183.—Types of globe onion. (Michigan Station.)

onions and is popular on the market. American onions are smaller in size, stronger in flavor, denser in texture, and much better keepers. The American varieties are earlier in maturing and are safer for growth in central and northern latitudes (Fig. 183).

Varieties.—Three distinct colors are recognized among the American onions; yellow, red, and white. Markets differ in their demands regarding color. Popular varieties of these colors are Yellow Globe Danvers, Red Wethersfield, Southport Red Globe and Southport White Globe.

Varieties of Bermuda types are Red Bermuda, White Bermuda, and Crystal Wax. Prizetaker represents a group of varieties of foreign onions midway in size and strength of flavor between the American and the Bermuda. Both Prizetaker and Gigantic Gibraltar are foreign varieties which succeed in northern climates. Spanish onions (Valencia or Demia) are somewhat grown in northwestern regions.

Job 3. Selecting Soil and Field; Deciding Acreage

Onion Soils.—Onions will not thrive on coarse, rocky soil, as they have very delicate roots. Soils that bake, or form hard crusts after rain, do not favor seed germination. They may be grown on any well-drained, fertile soil, muck soils being undoubtedly the best general type for the growth of mature onions from seeds. But rich black sandy loam which is well drained is well suited to onion culture and the crop succeeds on a variety of soils providing there is plenty of plant food. Natural fertility is highly important. Plenty of humus and well-rotted organic matter should be present.

Choosing the Field.—Onions are usually not grown in rotation. Plan to have a green-manure crop, such as clover or grass sod, turned under preceding the onion crop by several years. Some growers find that such a crop is not easily worked into the soil. They prefer to let a cultivated crop such as potatoes or corn follow the sod crop and grow onions the second year and for several succeeding years. The field should be well drained and located where it will have a good sunny exposure to aid in the curing of the crop of ripe onions at harvesting time.

Deciding Acreage.—The labor supply should be carefully considered when planning the acreage for onions. The tendency among growers to increase or decrease the acreage should also be considered. There is some danger of overproduction. It is often better to reduce the acreage than to increase it over the acreage of the preceding year. It is well to study the reports of the Bureau of Agricultural Economics, U. S. D. A.

Job 4. Providing Organic Matter

Onions require that the organic matter should be well rotted. The list of reasons for using organic matter in the soil is given in the tomato and melon enterprises.

Job 5. Obtaining Good Seed; Testing; Treating; Obtaining Sets

Onion Seed.—This is easily produced and saved by truck growers in dry climates. Good supplies of seed are found in the hands of seedsmen, and truck growers in humid climates usually buy onion seeds.

Testing seed by simple methods is advisable. The germination should be 90 to 95 per cent.

Treating seeds of these crops with hot water at a temperature of 122 degrees for 25 minutes as described for cabbage seed is believed by some to aid materially in controlling smut disease. Treating the seeds with mercury is also recommended.

Onion Sets.—For the production of green bunch onions, sets are often used. Ripe onions are also sometimes grown from sets. True onion sets are really small onions produced as a special crop of the variety desired. They are sold in the seed markets as dry ripe onions, but must have been stored away from frost. Sometimes inferior lots are offered for sale. They should be carefully examined before purchasing. Onion sets are used for bulb onions for home use and somewhat for market, as well as for green onions.

Onion sets may be produced by growers themselves if the conditions of soil are favorable. Usually lighter soil with much less plant food is best for growing onion sets.

Top sets are often produced on seed-onion crops. These may be harvested and used or may be purchased from seedsmen or others for use in growing either green onions or ripe onions.

Job 6. Buying and Mixing Fertilizers

Removal of Plant Food.—A 600-bushel crop of ripe onions removes from the soil 92 pounds of nitrogen, 93 pounds of phosphoric acid, and 101 pounds of potash. If the soil is rich in well-rotted organic matter much of the nitrogen may be supplied from the soil, but it may be advisable to supply two or three hundred pounds of nitrate of soda per acre if the soil is not rich but a high grade of tankage could be used for this and for a part of the phosphates. The phosphates may need to be supplied in the form of superphosphate. About 200 pounds or more of muriate of potash is recommended for muck soils or for light soils, but if there is a good supply of clay much of this may be omitted. On muck soils the fertilizer should be rich in potash.

The Cornell Station recommends N–P–K formulas such as 0–12–18, 3–12–18 and 0–10–10, at rates of 750 to 1,000 pounds per acre. Fertilizers without nitrogen are used on high-lime muck soils. A 5–10–5 mixture is suited to mineral or non-muck soil.

Many onion growers on non-muck soil apply 25 to 30 tons of manure to the acre in addition to a half ton of commercial fertilizer. Lime is used by some growers but is not so important as organic matter.

Job 7. Preparing Soil for Planting

Preparing Field.—Preparation of soil for onions is similar to that recommended for other truck crops. One can never have the surface too fine and smooth for onions, as the young seedlings are easily ruined by early cultivation if the soil is in bad condition. Weeds must be thoroughly sprouted out of the soil for this crop or they will choke out the small

seedlings. Thorough harrowing through a bare-fallow period to sprout all weed seeds is perhaps more important with onions than with any other truck crop. As the crop must be planted early, many growers find it advisable to plow the soil in the fall.

Job 8. Planting and Fertilizing

Planting Onion Seed.—Seeding should be done early as onions thrive in early cool spring weather. Hand seeders are best for drilling onion seed. A straight line may be stretched for the first row and a side marker may be followed for each succeeding row. A one-wheel drill will open the row, drop the seed, and cover it slightly. A packer behind will firm the surface sufficiently. Rows are commonly 14 to 20 inches apart. About 4 to 5 pounds of seed will plant an acre, but at this rate thinning will be required. If good tested seed is used the results may be rather satisfactory with 3¼ pounds of seed. If only a little over 3 pounds of seed are used per acre, thinning may be omitted. Thinning is much more common on mineral soils than on muck soils.

Fig. 184.—Ten-year-old girl with double-wheel hoe cultivating onions in the home garden. (Bateman Mfg. Co.)

Onion sets may be planted an inch apart in rows about 1 foot apart. This may be done in very early spring. They may be covered 1 to 2 inches deep.

When commercial fertilizer is used it may be spread just before planting and harrowed once. Nitrate of soda may be applied to the crop about the time of the first cultivation or after thinning is done.

Job 9. Thinning, Weeding, and Cultivating the Crop

Thinning.—When ripe onions are grown for market a much more uniform product is obtained if the crop is properly thinned while small.

If the stand is very thick thinning should be earlier than otherwise. Usually the work is done at the time of the second weeding. The soil should be moist for this work, as the permanent plants will be less disturbed. Leave the strongest plants about 3 inches apart but to suit the variety. The bulbs should not crowd seriously. Plants pulled out are sometimes transplanted to another row.

Weeding.—Onions are not good fighters of weeds. One cultivation with a wheel hoe should be made as early as possible after the plants are up (Fig. 184). Some growers mark the row with a little fertilizer or lime to aid in locating the row for the first cultivation.

Fig. 185.—When large weeds are pulled from the onion patch they may be put in weed sacks and carried from the field. (Michigan Station.)

Hand weeding in the rows is usually necessary after the thinning has been completed and cultivation discontinued. (Fig. 185.)

Clean cultivation should be given the crop until the bulbs are nearly grown. Avoid forcing additional growth by late cultivation or feeding.

Job 10. Controlling Enemies

Onion thrips are serious in some regions. If they are found, U. S. Farmers' Bulletin 354F should be studied. Onion smut is the most serious disease. It is controlled by formaldehyde solution, 1 oz. of 40 per cent formalin to one gallon of water, applied from tank on seed drill at time of seed sowing. Other diseases are not common, but U. S. Farmers' Bulletin 1060F should be used in guarding against any which may occur.

Job 11. Harvesting, Curing, and Grading

Harvesting.—Harvesting should begin as soon as maturity is indicated by the shriveling of the stems near the ground. Loosening is not necessary on muck soils where most bulb onions are grown. On others the bulbs are loosened from the soil by a wheel hoe having two wheels straddling the row. A U-shaped cutter runs beneath the row. The bulbs are easily lifted by hand and laid on the bare soil to dry.

FIG. 186.—Well-matured onions curing in windrows before topping. (Michigan Station.)

Curing.—The crop must not be stored or put in large masses until thoroughly cured by drying in the open air. The bulbs are put in small flat windrows (Fig. 186) on the surface of the soil, and should be turned after each rain or oftener.

Crate curing is practised in some regions. Slatted trays 4 inches deep or bushel slatted crates are used for this purpose. At harvesting time these trays or crates are filled with bulbs from which the tops have been removed by twisting a bunch at a time or, preferably, cut, leaving one inch of stem. The trays or crates are stacked one above another in the field or in a curing shed or similar building for several weeks if desired.

If stacked in the field, the top crates are covered with boards or roofing paper to keep out rain. Bulbs may be topped during the curing period. Topping with shears is common in some regions. Bulbs are handled separately. This method adds greatly to the expense of the crop.

Grading usually follows the curing period. Onions are graded according to size and all culls are removed. Any which have started a second growth or have matured improperly are discarded.

Job 12. Storing the Crop

In northern states much of the onion crop is sold before freezing weather, so that storage is unnecessary. But in some years a large part of the onion crop is stored. Since they require a dry atmosphere, onions cannot be stored in the ordinary house or storage cellar. Where they are kept in storage a temperature of 30 to 32 degrees F. should be maintained as uniformly as possible. Some of the crop is stored on farms, but a large percentage is stored by dealers in onion regions.

If cured in crates, the crop may be kept in the curing shed until time for marketing, and thus make other special storage unnecessary.

Job 13. Marketing

In some regions onion associations are formed for marketing this crop. For the earliest crop produced by planting onion sets the bulbs are marketed from the field as soon as possible. The price at that time is often very satisfactory and extra handling of the crop is avoided for all that can then be sold.

The late crop is usually not sold until late fall or winter, and the markets are kept supplied as needed during the season. In northern and central regions the crop should be sold before the crop in the Gulf States is harvested. Prices are likely to be affected when the southern crop appears in the market.

The Bureau of Agricultural Economics, U. S. D. A., has established definite rules or standards for the marketing of onions and other vegetables. These should be studied and complied with, particularly if the crop is to be shipped to a distant market.

Job 14. Keeping Accounts

(See forms in apple enterprise.)

CHAPTER XI

BEETS AND OTHER ROOT CROPS

Analysis into Jobs.—The managerial and operative jobs in enterprises with garden root crops such as beets, turnips, salsify, carrots, rutabagas, radishes, and parsnips are included in the following teaching units. For forms of analysis into problems, see other truck-crop enterprises. References are to U. S. Farmers' Bulletins. See also *Field-Crop Enterprises* (Lippincott).

1. Determining possibilities with one or more of the root crops.
2. Choosing the crop and variety; procuring seed, 1390F.
3. Selecting soil and providing plant food.
4. Preparing soil and planting.
5. Cultivating the crops.
6. Controlling enemies, 1345F, 1371F.
7. Harvesting and marketing, 1594F.
8. Keeping records, 511, 572, 782, 1182.

Job 1. Determining Possibilities with One or More of the Root Crops

Climatic Requirements.—Beets and carrots are grown extensively in all climates of this country, as they endure both hot and cold weather well. Turnips do not withstand summer heat, but are more extensively grown than other root crops in gardens in all sections. They are grown in early spring and late fall instead of in the summer season. They are used for greens as well as for roots. The growth of carrots is widespread throughout the northern, central, and southern latitudes. The growth of parsnips and salsify is more closely confined to northern latitudes, but they are often found in gardens of the central region.

Market Possibilities.—In the large markets the most popular root crops of this group are radishes, carrots, rutabagas, beets, and turnips. Salsify and parsnips are much less popular, and very small crops are usually sufficient to supply market requirements.

Ease of Growth.—In order of least labor requirements, these crops may be ranked as follows: radishes, turnips, beets, carrots, parsnips, rutabagas, and salsify. Their productivity is almost in the same order.

Job 2. Choosing the Crop and Variety; Procuring Seed

Varieties.—Turnips are of several types; common white-flesh turnips are popular in the leading markets. Good varieties are Purple Top, Improved Red Top Globe, and Seven Top (for greens).

Rutabagas or yellow-flesh "Swedes" are often sold in markets, particularly for winter use (Fig. 187). This type sometimes prevails in regions where many foreign inhabitants are found. They are often grown to feed to livestock. Yellow Aberdeen is a good variety.

Beets for early use on the table or in markets may be classified into two groups according to shape. The most popular variety of the flat beets is probably Extra Early Egyptian. Varieties of the globe type are

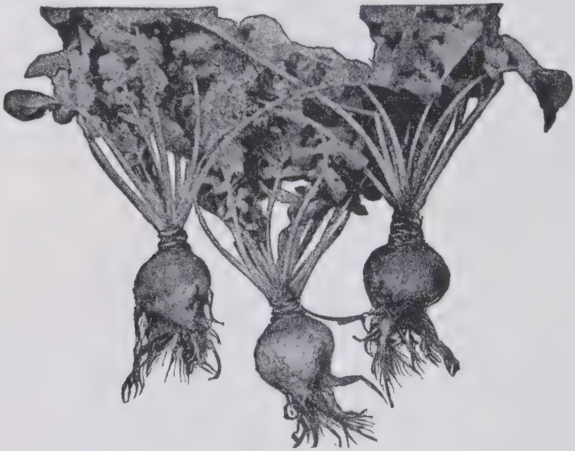


FIG. 187.—Bloomsdale rutabagas; a form of yellow turnip that keeps well for winter use. (Cornell Station, in *Productive Feeding*.)

Detroit Dark Red, Crosley's Improved Egyptian, Edmand's Blood Turnip, and Crimson Globe.

Carrots are of three main types of root. Early Scarlet Horn is very short and somewhat globular or cylindrical. Half-Long Danvers (Fig. 188) and Chantenay are rather long in form. Varieties of intermediate form between the two extremes are Nantes or Coreless, Scarlet Intermediate, and Oxheart. For stock use, good winter keepers are White Belgian and Yellow Belgian.

Sugar or Hollow Crown is a good table variety of parsnip.

Salsify is sometimes called oyster plant because of its flavor. Mammoth Sandwich Island is the most popular variety.

Buying Seed.—Nearly all of these crops are biennials, but turnips

often produce seed in the second growth of the first year. It is usual and probably best for gardeners to purchase seed from the regular trade, as it is difficult to save seed from the home garden.

Treating Seed.—Soak seed for 10 minutes in mercury solution, 1 ounce in 8 quarts of water.

Fig. 188.—Two types of carrot, Improved Rubicon (left) and Half-Long Danvers (right), showing how they are bunched for market. (Cornell Station, in *Productive Feeding.*)

Job 3. Selecting Soil and Providing Plant Food

Soils.—These garden root crops demand well-drained soils. They thrive best on sandy loams. Plenty of available plant food improves the growth remarkably. Muck or peat is considered ideal for carrots and beets. In cannery districts silt loam is often used for beets. The application of fresh manure to the soil is detrimental to beets, as it tends to produce scab and a rough product. If green-manure crops can be turned under, this should be done the fall before the soil is prepared for planting.

Fertilizers.—It is the surest plan to supply quickly available plant food in the form of commercial fertilizers. Nitrate of soda and superphosphate (acid phosphate) should aid greatly in the production of these crops. The use of potash is particularly important on rather sandy or muck soils.

Job 4. Preparing Soil and Planting

A Good Seed Bed.—For most of these crops it is very important that a very perfect seed bed be prepared before planting. The soil should

be harrowed until it is very fine and the surface should be planked if possible just before planting.

Planting.—The rows may be marked off with any good garden marker which will produce rather shallow furrows or marks. Most of these root crops are planted in rows and cultivated with small implements. This system allows the rows to be planted as close together as onions, fourteen to twenty inches. Turnips are often sown broadcast, particularly those of the white variety or of varieties used for greens. When seed is to be drilled in rows, a common garden seeder may be used to good advantage. This machine works better for turnips and beets than for the other types of seed. Carrots are planted with seed drills in commercial production. Hand methods are commonly used for salsify and parsnips, and sometimes for beets and carrots.

Double rows are sometimes drilled if horse cultivation is to be used. The two rows are drilled as close together as six or eight inches, so that a little hoeing may be done between the rows in the early stage of growth. Two and one-half or three feet is allowed between the pairs of rows.

Companion Croppings.—It is common to mark the young rows by planting turnips or radishes with carrots, parsnips, and salsify. The turnip and radish seeds sprout quickly and show large seed leaves. These plants show the rows for the crops which have very small leaves at first. Rows can be cultivated much earlier under this method of planting. The method, however, is not practical where seeders are used. Sometimes a streak of lime is distributed on top of the soil for each row planted. This aids in locating the row at the first cultivation. Some such method is important for carrots, parsnips, and salsify, but less so for beets.

Job 5. Cultivating the Crops

Clean Tillage.—Cultivation should begin early and should be repeated often to prevent weed growth and to stimulate growth of the crop. Hand weeding must be practised and some thinning may be necessary, particularly for garden beets. The so-called seeds of beets are really seed balls containing two to five or six seeds, and several plants grow from each. This requires early thinning to prevent crowding. Do not thin too much at first, as additional thinning may be done when the most advanced plants are ready for table use. Beet leaves are often cooked for greens. Some growers transplant beets at thinning time, but this practice is of doubtful economic value. Carrots may be thinned to proper distances when they have formed roots large enough for table use. Salsify and parsnips should be thinned early if they are too thick.

Turnips are often sown rather thick with the intention of using the

thinnings for early greens. The plants may be pulled and used for greens as soon as the leaves are large enough. This plan is common in southern regions.

Hand Implements.—These crops are often cultivated with wheel hoes and other hand tools (Fig. 189). The tools may be adjusted to suit conditions, such as width between rows and type of soil. As many rows can be cultivated by hand as with a horse when such implements are used.

Fig. 189.—Every gardener who believes in "preparedness" will have these implements in his tool house.

Job 6. Controlling Enemies

Plant Lice.—Aphids are probably the worst enemy of turnips. They attack the under sides of the leaves in great numbers and often ruin the crop. Economical methods of fighting them have not been found. If the insects come early, the crop should be plowed under immediately to prevent multiplication of the lice. Dusting with tobacco dust or spraying with nicotine sulfate are good remedies if applied early and if the cost is not too great in comparison with the value of the crop.

Carrot Worms.—These larvæ strip the leaves of carrots and often attack parsnips and other related crops. They can readily be controlled by spraying or dusting with arsenate of lead or similar poisons.

Scab.—This disease is likely to attack beet crops seriously. The trouble is increased by the use of fresh barnyard manure on the soil before planting, which sometimes introduces the germs into soils. Seed should be

FIG. 190.—Early Egyptian beets are a popular market variety. (*Productive Vegetable Growing.*)

treated before planting with corrosive sublimate or formaldehyde (see Index). This prevents the introduction of scab disease into new soils. Avoid growing beets on a soil on which a scabby crop of beets or potatoes has been grown. The disease is similar to that found on Irish potatoes.

Nematodes.—These small animals are apparently becoming worse in many regions. More soils become infested with this enemy, and no satisfactory remedies have been discovered. The animals may live in the soil many years. Crops which are subject to the attacks of this enemy should not be grown on infested soils. Grow crops immune to the nema-

todes, such as corn, small grains, and clover. Soils which have become infested should be entirely abandoned for garden purposes, as many other garden crops may be attacked. (U. S. D. A. Farmers' Bulletin 1345.)

Job 7. Harvesting and Marketing

Early Market Crops.—Beets, turnips, and carrots may be harvested as soon as they are large enough for market or table use. No definite stage of maturity for these early crops is necessary.

Mature Crops.—When roots are to be stored for winter or to be marketed in the mature stage, they should be allowed to complete their growth or remain in the soil as long as growing conditions are favorable. Parsnips and salsify are usually marketed in the mature stage. Beets, rutabagas, and stock carrots are often allowed to complete their growth or to remain in the ground until the end of the growing season.

Fig. 191.—A school garden market. (Department of Horticulture, Kansas State College.)

Bunching.—The early crops are usually pulled with the leaves on, washed, and tied in bunches for market. They are sold in bunches of sizes to suit the markets. Some markets require that the leaves be cut off. In that case, the stems of the leaves are tied together.

Marketing.—Mature crops are often sold in crates or baskets. Crates of bunched roots may be shipped for sale in early markets. If bunched roots bear the leaves, they must be kept in very fresh condition until sold. The product must be delivered to the market daily in fresh, attractive condition. Trucks are often used to secure quick delivery (Fig. 191).

Job 8. Keeping Records

(See forms in apple enterprise.)

Radishes

Any good garden soil is suitable for radishes. The depth of soil may be less than in the case of other root crops. Radishes mature quickly and must be tender and crisp to be relished. Many gardeners plant radish seeds with other seeds so that the young plants will show the row quickly, and thus allow earlier cultivation. The radishes are later pulled out from among the other plants and used on the table. The best crops of radishes are grown in rich soil with plenty of manure, and abundant moisture. The crop is very hardy, and should be planted as early in the spring as the soil can be worked. A succession of plantings may be made about ten days or two weeks apart. Thinning is not necessary, except that as the largest roots reach edible size they may be pulled to make room for others.

Fall crops of radishes are as much relished as the spring crops. They thrive in the long cool season of the autumn. The earliest fall sowings may be made in August, and the latest sowings may continue to grow until time for the ground to begin freezing. At this time of year weeds are less troublesome, and the seeds need not be sown in drills but may be sown broadcast on a well-prepared soil and covered with the rake. A pound of seed will sow one-tenth of an acre. In drill rows allow an ounce of seed to fifty feet.

Radishes vary in their response to environment. Some varieties will "go to tops" under conditions that are good for the growth of a crisp salable root in other varieties. It is desirable to become acquainted with the best kinds for a given location before attempting to grow this crop on an extensive scale.

For late summer radishes the small-rooted, quickly maturing kinds cannot be used. There are two or three varieties adapted to hot-weather growing conditions. These are not used extensively for relishes as are the spring and fall kinds. They grow to the size of a small turnip and when sliced are used in salads and sandwiches. Their use is very limited and they do not ship or store well.

CHAPTER XII

ASPARAGUS ENTERPRISE

Analysis into Jobs.—The main operative and managerial jobs involved in the asparagus enterprise are included in the following teaching units. The references are to U. S. Farmers' Bulletins.

1. Determining possibilities with asparagus, 1646F.
2. Choosing type and variety; procuring seed or plants, 829.
3. Selecting soil and providing plant food, 1646F.
4. Preparing soil and planting, 1646F.
5. Cultivating the crop, 1646F.
6. Controlling enemies, 837F.
7. Harvesting and marketing, 462T.
8. Production of pistillate and staminate plants.

Job 1. Determining Possibilities with Asparagus

Regions.—Central and northern latitudes are suited to this crop as it thrives well under cool climatic conditions. The crop is important in South Carolina and other southern regions. Most of the canned asparagus is grown in California. Hot weather causes the shoots to become slender and less suited to marketing conditions.

Capital and Labor.—The original cost for purchased plants is rather great, but the beds may be maintained for many years. Growers can grow their own plants in one year. The annual labor requirement is perhaps less than for most truck crops, the harvesting, grading, and marketing causing most of the labor each year after the bed or field is established.

Job 2. Choosing Type and Variety; Procuring Seed or Plants

Market Demand.—Blanched or white asparagus is preferred in some markets, though on eastern markets "green" is now more popular than the bleached type because of its distinctive flavor. Popular varieties for eastern markets are Mary Washington and Martha Washington. Old-fashioned sorts are Palmetto, Columbia White, and Colossal. Growers desire a variety that has resistance to disease and high yield. Heads should be close and shoots strong. Early production is essential unless there is danger of frost or the crop is grown for a cannery.

Variety strains have been established which are largely immune to

asparagus rust. Where this disease is prevalent one should grow resistant strains, as the Washington. Growers may save seed from plants showing no disease or obtain guaranteed seed or crowns from dealers.

Seed and Plants.—Growers often produce their own plants by starting them from seed. One or two years before the plants are needed, seed may be drilled in rows one and one-half feet apart, in the early spring. As they germinate slowly they should be soaked to hasten growth. Rows may be marked by sowing turnip or radish seed, the plants to be later pulled out. Young plants should be weeded and thinned, and must be cultivated often during the first and second years. Strong plants are ready to be transplanted in one year and are preferable to older plants.

Fig. 192.—Tray of bunched asparagus ready for packing. An inch or two of water is left in the tray to prevent wilting. (U. S. D. A.)

Obtaining Plants.—One-year-old plants are best to purchase. Thick, heavy crowns should be chosen. Avoid weak plants. Unless you know the growers, be careful to buy from a reliable nurseryman.

Job 3. Selecting Soil and Providing Plant Food

Soils.—Organic matter is less important for asparagus than for most vegetable crops. Sandy soils are preferred by asparagus growers and soils cannot be too rich in organic matter. For the young plants it should be well decomposed. Soils which have been manured for a preceding cultivated crop, such as potatoes or corn, should be well suited to growing asparagus. Heavy applications of manure may be plowed under in the fall. This gives time for the settling of the soil and for the rotting of the manure. Well-rotted manure may be used in spring if plowing has been delayed until that time.

Nitrogenous green manure obtained by turning under clover or grass sod should be rotted for one year, or at least over winter. Disking will hasten the decay of green manure.

In addition to manures, commercial fertilizers are applied by the most successful growers. A half-ton or a ton to the acre of 5–8–7 (N–P–K) fertilizer is often applied at the end of the cutting season, where no manure is used. The commercial fertilizer need not be applied in early spring.

Job 4. Preparing Soil and Planting

Preparation of Soil.—To receive crowns transplanted from seed beds or from a nursery, the soil should be well prepared as for other truck crops. If soil has been plowed in the fall it is usually well to plow it again

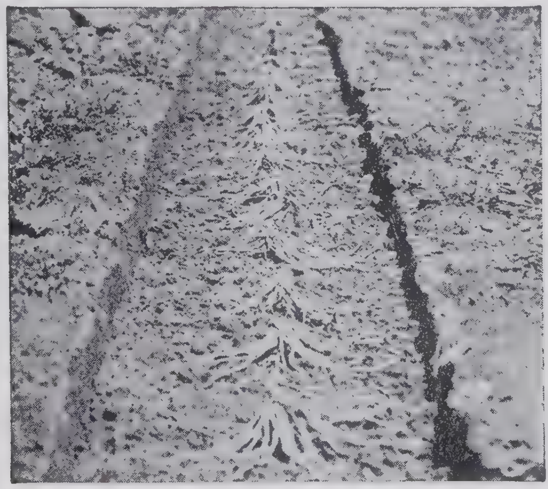


Fig. 193.—Setting asparagus. The trench is well drained and supplied with compost and rich soil. The roots should be spread as shown. (U. S. D. A.)

in the spring just before transplanting time. Disking and harrowing should be thoroughly done. Rows are laid out with a turning plow or with a double moldboard lister, to a depth of eight or ten inches, and usually about four feet apart. If soil is not as rich as desired a forkful of rotted manure may be applied in the furrows for each plant.

Setting Plants.—(Fig. 193). Strong plants may be placed two feet apart. Weaker ones may be closer. Spread roots well in the furrow. Crowns should be six to eight inches below the level. Do not cover the crowns more than two or three inches deep at first. As they grow add more soil until the furrows are filled by the end of the season.

Job 5. Cultivating the Crop

Till Early.—As young plants begin to grow, soil should be worked toward them with cultivators. This will aid in keeping down weeds in the rows. When furrows are entirely filled and the surface is level, the movement of soil towards plants should cease, as it will tend to cause crowns to form buds too high.

Cultivation may cease when the tops are so large as to fill the rows. No weeds should be allowed to appear. This is the main purpose of tillage.

Mowing Tops.—The heavy top growth produced during the first season in the field should all be disked under in very early spring. After this the soil is sometimes turned with a plow running shallow enough not to disturb the crowns. Many growers never turn the soil.

Protecting Crowns.—Where manure is cheap, crowns are sometimes covered by a heavy dressing of barnyard manure. This should be partly rotted if possible. Some growers scatter the manure over the whole field. In spring before growth begins the surface is thoroughly disked or double-disked. Do this as early as the season will allow. Several harrowings should follow. Do not be afraid of injuring crowns by this early spring work.

A little light cultivation between rows should be given in early spring. The work each fall and spring is repeated as described. In northern sections cutting for market should not begin until the third spring.

Job 6. Controlling Enemies

Rust Disease.—The worst enemy of this crop was formerly asparagus rust. It often reduced the yield and entirely ruined the plantation. Choosing strains which are resistant to disease is the best means of prevention. This has solved the problem. Other strains should not be grown. Spraying against rust disease is not practical.

Asparagus Beetle.—The common asparagus beetle is very troublesome in most sections. This beetle is controlled (1) by spraying or dusting with poison after the cutting season; (2) by letting a trap row grow every 25th or 30th row during the cutting season and keeping it well sprayed with lead arsenate. Chickens running in the field also tend to keep down this pest.

Job 7. Harvesting and Marketing

Cutting.—Butcher knives kept sharp on the round end or regular asparagus knives with sharp ends may be used in harvesting the crop. The operator soon learns the depth of the crown and should cut at the

base of each shoot as deep as the crown will allow without injury. For blanched asparagus the shoots are cut every morning and all that show above the surface should be taken.

The cuttings are placed in a basket or tray and taken to a packing shed or platform, where they are washed, sorted, and tied into bundles of an even size. There are usually not less than 12 stalks in a bunch. They are trimmed evenly at the base. This may be done with an ordinary butcher knife or with a special machine. The tying may be done with tape or with soft string which will not cut the shoots. Bundles must be neat to attract buyers.

Marketing.—After bunching and tying, the crop must be marketed immediately. Crates for asparagus are of a depth to suit. They are made of light material for shipment by express or trucks to market. Northern crops are seldom shipped in carload lots, as markets can be found near enough to warrant shipment by express. Coöperative associations are sometimes formed and shipment may then be made in carload lots.

Canning.—Most asparagus is canned in California; this is blanched. In some other regions, where local canneries are found, the crop is cut green and sold by contract. The price is usually fixed at so many cents a pound for 5½-inch stock, field run, without packages. Baskets of any kind are used by growers to haul the "grass" to the canning factory.

Job 8. Production of Pistillate and Staminate Plants

As a rule the asparagus plant is diœcious. Diœcious plants are those which produce pistillate flowers on one plant and staminate or pollen producing flowers on other plants. It is on the pistillate plants that seed are produced. There is no way to determine if a plant is going to produce pistillate or staminate flowers until it has come into flower and one can examine the bloom.

Although the grower of asparagus for the market is not interested in seed production, he can profit by studying the flowers on the plants produced and roguing out the pistillate-flower producing plants. It has been found by carefully conducted tests that the staminate-flower producing plants yield from 25 per cent to 50 per cent more salable asparagus than do the pistillate or seed-bearing plants. This is probably because the shoots for one spring are produced from buds developed the previous summer, and it is likely that while the seed producing plants are using the plant foods for the making of seed the "male" plants are using this food for the making of larger buds which in turn make larger shoots the next year.

CHAPTER XIII

RHUBARB ENTERPRISE

Analysis into Jobs.—The teaching units, in a rhubarb enterprise, including the operative and managerial jobs, are here listed. For form of analysis into jobs, see other truck-crop enterprises. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with rhubarb.
2. Choosing variety; procuring seed or plants.
3. Selecting soil and providing plant food.
4. Preparing soil and planting.
5. Cultivating the crop.
6. Renewing a planting.
7. Harvesting and marketing, 1471, 1551.
8. Forcing rhubarb.
9. Keeping records, 511, 572, 782, 1182.

Job 1. Determining Possibilities with Rhubarb

Use.—This crop is sometimes called pie-plant because of its extensive use in making pies and sauce. The fleshy stems of the leaves produce a very edible product in early spring when other garden vegetables are not abundant. These early stalks produced are most in demand. After the leaves are pulled from the underground buds, new leaves spring up. Harvesting may continue until the demand is low. Leaves coming later are allowed to remain to gather food materials for the plant during the remainder of the season.

Climatic Requirements.—The crop is most popular in northern and central latitudes. It is seldom abundantly grown in southern regions. The roots and underground buds are very hardy and withstand the winters of the extreme north. As the crop desired is harvested in early spring, the heat of summer is seldom a serious handicap for the production of rhubarb.

Labor and Capital.—This crop compares favorably with asparagus regarding labor and capital requirements. Beds well established may be kept many years and the original cost of roots may be divided among the many years. The crop, however, is less popular in the markets than asparagus, and smaller areas should be grown.

Market Demands.—Growers should investigate the market conditions before planting rhubarb. A small patch may satisfy a family for home use. If the available markets will not buy much rhubarb, the

grower may be disappointed in producing a large crop. The extreme acidity of this crop is probably a handicap to its popularity. Many people use little or none of this product.

Job 2. Choosing Variety; Procuring Seed or Plants

Crowns.—Rhubarb roots or crowns are multiplied by division. When plantations are old, roots are dug and divided. Strong crowns may be developed from small ones. This is the commonest way of propagating rhubarb. Avoid planting pieces which do not bear buds.

Nurserymen also start crowns from seed, and new strains are thus produced. This plan requires one or two years to develop strong crowns. New plantations are often started with one-year-old roots from seed. This plan costs much less than buying large roots. A serious objection to starting roots from seed is the wide variation in the plants after they are grown. Careful selection is necessary to get a uniform product.

Job 3. Selecting Soil and Providing Plant Food

Rhubarb Soils.—Soil for rhubarb cannot be too rich. Heavy applications of barnyard manure may be made in addition to the plowing under of green manure. For the most successful growth, the manure should be well rotted at first. Heavy applications may be added each year and worked into the soil.

The subsoil should be rather well drained to prevent decay of old roots. Rather heavy clay loam with plenty of organic matter should produce a good growth of rhubarb.

Job 4. Preparing Soil and Planting

Soil should be plowed very deep the preceding fall if possible. In the spring, work up the surface with a disk harrow set very deep. Then mark out the rows with a turning plow so that the roots may be planted in a deep furrow with plenty of loose, friable soil. The roots should be set so that the crowns are about even or slightly below the general surface of the ground. Place the crowns about four feet apart in the rows and firm the soil about each root to bring plenty of moisture to the plant. The rows should be at least four feet apart. The number of plants required per acre set four by four is 2722.

Seed Beds.—For growing the plants from seed, beds should be made in rich, moist soil in early spring. Drill the seeds in rows about eighteen inches apart. Soon after germination, thin the plants to six or eight inches apart in the rows.

Job 5. Cultivating the Crop

Annual Care.—Clean tillage should begin early in the season, continuing throughout the season if for weed control only. In the fall, heavy applications of barnyard manure can be placed over the crowns of the plants as well as between the rows to allow the winter rains and snows to leach the fertility into the soil. In early spring, rake some of the manure from the crowns to allow the leaves to shoot up. Manure may be added in the spring as a mulch, cultivating some into the soil soon after growth begins.

Job 6. Renewing a Planting

When leaf stalks become puny in size, starvation of the plant is indicated. This may be due to overcrowding of the roots or to underfeeding of the plants. If the plants are old, a division of the roots is the best remedy. Usually the whole plantation should be moved. Often it is well to plan this a year or two in advance, preparing the land as recommended for a new planting, starting with new plants. When the new planting is producing, the old may be plowed under and the land used for other crops. If this is not practical, root pruning, heavy fertilizing, and some irrigation will improve the crop in the succeeding years.

Job 7. Harvesting and Marketing

Harvesting.—Avoid harvesting leaves from a newly set rhubarb plantation. It is best to wait until the third year after planting before harvesting from roots which were started from seed. If the crowns were very heavy at setting time, some crop may be harvested the second year. Only about half a cutting should be made.

If the leaves are pulled each spring, care should be exercised not to destroy the central crown bud in the center of each whorl of leaves. Leave plenty of foliage to support the plant after each pulling. A straight pull in the direction of their growth will separate them from the crowns at the natural joints. This is less harmful to the plants. Pulling the outer leaves may continue for several weeks, after which the plants are allowed to build up the buds by retaining their leaves the remainder of the season. Unless seeds are desired for propagation, the flower stalks sent up by any of the plants are cut off before they exhaust the strength of the plants.

Preparing for Market.—The stems of rhubarb are tied in bunches similar to asparagus bunches. They are made even at the base and trimmed even at the top. No leafy growth should remain. In some markets a little green is allowed at the top of the stem. The bunches are packed in crates as is asparagus, small bunches being most attractive. Three

stalks constitute a bunch early in the spring, the number increasing to twelve as the season advances.

Job 8. Forcing Rhubarb

Forcing rhubarb is not difficult, but it must be done correctly. Haphazard methods and lack of attention to details are the causes of most failures in rhubarb forcing.

Success in rhubarb forcing begins in the field the summer previous to the forcing. Nothing but healthy, large plants grown on well-fertilized, properly watered, and thoroughly cultivated land should be used.

The roots are dug out after the tops have died down in the fall. When only a few roots are to be used, dig each plant out with a spade, having a ball of soil 15 to 18 inches in diameter around the crown of the plant. Be careful not to injure any of the buds in the crown. If a large number of roots are to be forced, the work may be lessened by loosening them by plowing along both sides of the rows and lifting the ball of soil and roots with the aid of a spading fork.

The next step is the freezing of roots. The plants may be left in the field until frozen, or refrigeration may be used. After freezing, the roots are rested by keeping them frozen until the forcing begins.

When ready to begin the forcing, place the clumps close together on a pad of soil, filling the spaces between clumps with additional soil. There is no need of using a rich soil, as rhubarb uses food already stored in the roots. Water the planting slowly but very thoroughly; it is very dry at this time and considerable water will be used. After each watering, look the beds over carefully and refill any soil that was washed away or which has settled.

During the forcing period the temperatures must be kept even. Rhubarb will grow slowly at 48° F. At 55° the crop will be ready to cut in about three weeks, the beds producing for about 30 days. All forcing must be in the dark to produce the colorless stalks demanded.

The stalks should be harvested as soon as they are of marketable size. To pull a stalk, take it at the base and break from the crown without injuring the buds still underground. Brush any soil or dirt from the stalk, but do not wash unless the stalk is to be immediately consumed.

Forced rhubarb is usually sold in bunches of four large stalks and tied with tape. If the stalks are small it is better to increase the number of stalks rather than to decrease the size of the bunch. One can expect a production of about 4 pounds per square foot from forced rhubarb. After the plants have been forced they are practically worthless and should be thrown away.

Job 9. Keeping Records

(See forms in apple enterprise.)

CHAPTER XIV

HORSERADISH, SEA KALE, AND ARTICHOKES ENTERPRISE

Importance.—This crop is an appetizer or condiment made from the roots of the horse-radish plant. They are grated and stored in vinegar, very little vinegar being used. There is a constant and steady demand for the product in all regions, but the amount consumed is very light. Very few plants will produce enough roots for home use and a few short rows will supply a local market. Unless a local horseradish factory is preparing the product for market, the demand will probably be very limited.

Regions.—This crop may be grown in all climates and is well adapted to growth in any good garden soil. When once established, the plants persist indefinitely.

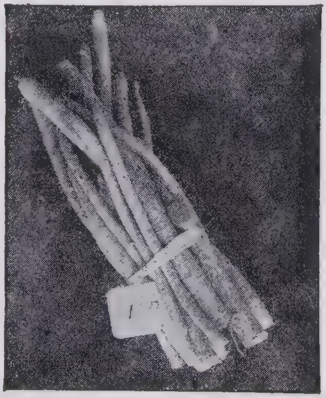


FIG. 194.—Horseradish is started by setting small roots such as those shown here. (Cornell Reading Circle Leaflet.)

Propagating Plants.—The young plants are usually started from fingerling roots taken from the sides of the older plants at harvest time. These may be set in the fall or spring and will begin growth as spring weather comes on. Propagation by seed is seldom practised, as seeds are not often produced.

Planting.—The roots for planting should be about five or six inches long and should be cut off even at the top when they are dug (Fig. 194). For planting, make deep furrows or trenches so the roots may stand upright and may be placed a few inches below the top of the soil. Be sure to set the roots with the tops uppermost, to prevent the production of crooked, gnarly roots.

Caring for the Crop.—Keep the weeds away and cultivate the rows well. There are no insects or diseases of economic importance.

Harvesting.—This crop stands hot weather and grows well during the summer if there is plenty of moisture and if the soil is rich. The best growth of horseradish is made during the cool fall weather. For this reason, harvesting should not take place until late. Plan to complete the harvest before winter weather begins. Dig or plow out the roots

completely. Sort them according to size and retain the long slender roots for replanting. Those to be sold or used should be trimmed and are often tied in bunches.

Marketing.—The whole roots are seldom sold in markets, but this product is sometimes found in late fall or early winter in large markets. If the crop is produced for sale to a horseradish factory, no tying is done; the crop is sold by weight. The factory grinds the roots either alone or with white turnips, the latter being used to modify the intensity of the flavor. As already stated, the product is preserved in vinegar and is bottled for table use.

Gardeners sometimes grind and sell their own horseradish in local markets.

Sea Kale

This crop is used as a substitute for asparagus. The succulent leaf stalks are cooked in much the same way. The crop is even earlier in its spring growth. The plants are propagated either from seeds or from cuttings. They are set in rows three or four inches apart with the plants about two feet apart in the rows. No leaves should be cut until the plants are two or three years old. As in the case of rhubarb the seed stalks should be cut to prevent taking the strength of the plants. Heavy applications of manure should be made each fall to aid in producing strong, succulent growth. As the stems are to be blanched before using they are covered to exclude the light either with coarse litter or with crates or boxes.

Globe Artichoke

The edible portion of the globe artichoke is the undeveloped flower bud which is sold in the large markets. The crop is propagated largely by seeds sown under glass in hotbeds or cold-frames which may be transplanted to the open garden in two months in a rich black soil. The plants are set three or four feet apart each way, and should be given clean tillage. They will yield some buds the first year if started in February or early March.

The crop is chiefly grown in regions where the winter is not severe. During cold winters the plants should be covered with soil or coarse litter.

Many side shoots or suckers start from the plants each spring, and these may be used to start new plants. A portion of the cluster of flower buds should be taken with each shoot. Plant the crop among other perennials, as the plants will live for three or four years.

Jerusalem Artichoke

There has been a growing interest in the Jerusalem artichoke as a source of raw material for the manufacture of plant products. It has been grown to a limited extent in gardens over the country, and in a few areas it has been grown on a field scale as a stock feed and forage plant.

Some persons believe that the crop will give high yields with a very meager water supply. The Jerusalem artichoke cannot be recommended as a dry-land crop. In irrigated areas it requires heavy applications of water, for although the plants may survive periods of drought and recover to make a small yield, water shortage very seriously prevents normal growth and tuber development. The plants are killed by the first frost in the fall, and the crop is of doubtful value in regions having a growing season of less than 125 days.

Varieties.—Although innumerable forms, stocks, and strains of the Jerusalem artichoke are in existence, well-defined and described varieties are practically unknown to growers. Mammoth French White, French White Improved, and other variations of supposedly the same name are most frequently mentioned by growers and writers. These names, as used at present, refer only to a general type rather than to a specific, well-defined, and recognizable variety. The stocks obtained from different sources will be found to differ widely with reference to plant habit, tuber shape, tuber color, and yield.

Soils and Fertilizers.—An impression that has become general is that the Jerusalem artichoke is a "poor-land crop"—that it does well on worn-out or marginal lands. It yields markedly more on rich soils than on poor. It also requires a soil that is well drained. The crop is best adapted to rich sandy loams, and to well-drained river-bottom or alluvial soils. Soils well suited for potatoes or corn are well suited for artichokes, except that artichokes should not be grown on distinctly heavy soils. It remains to be determined how much fertilizer can profitably be used.

Planting.—Tubers should be planted just as early as possible in the spring, as soon as the soil can be satisfactorily worked, regardless of location. There is apparently no danger of planting so early as to affect yield adversely. Late planting usually reduces the yields and the size of tubers. Whole tubers or tuber pieces about 2 ounces in size should be planted. These should be planted 4 inches deep, 2 feet apart in the rows, with the rows 3 to 3½ feet apart.

Cultivation.—Cultivation should be shallow, sufficient only to control the weeds thoroughly. Little, if any, cultivation will be required after stolon formation is well under way, since by that time the plants should practically meet between the rows and shade out the weeds.

Harvesting.—It has been implied that one of the remarkable features of the Jerusalem artichoke is its capacity to produce a large yield of tubers and at the same time a large yield of forage. The plant does not do both. Either a crop of forage or a crop of tubers can be harvested from a planting, but not both.

The maximum yield of green tops is available at, or just before, the time the plants blossom. After this, the yield of green tops and also the yield of dry matter declines rather rapidly. If the tops are left undisturbed until frost, to obtain the maximum yield of tubers, they are of little or no value for forage. The first frost blackens the leaves, and they soon dry out and shatter from the branches.

Before the tubers can be dug from the soil it is necessary to cut and remove the large woody tops from the rows. Turning out the tubers with a plow leaves a relatively large proportion of the tubers in the soil and also requires much scratching out by hand. Hand digging with forks probably yields the largest percentage of the tubers present in the soil but is laborious and expensive. Special machinery adapted to the wide distribution, the generally small size, and the delicate structure of the tubers is not yet available.

Storage.—The Jerusalem artichoke tuber has no heavy corky layer or skin as has the potato tuber. Therefore, the tubers are difficult to store for more than a very few weeks without heavy loss. However, they usually keep perfectly if left undisturbed in the soil until they are needed for use. Even the freezing of the soil does no damage if it is not poorly drained soil. Good, sound, disease-free tubers can be successfully kept several months in cold storage at a high humidity and a temperature of 32° F.

Yield of Tubers.—Acre yields of 15 to 16 tons or more, obtained under very favorable conditions where every precaution is taken to insure good crops and to harvest the tubers completely, have been had. The average yields over three seasons for several locations are but 8 to 10 tons an acre and it seems likely that ordinarily average yield will not be far from 5 to 6 tons. The estimate applies to commercial acreages grown under ordinary farm conditions in the East, South, and Middle West.

Cost of Production.—No definite costs of production of Jerusalem artichokes under commercial conditions of culture are available. Various estimates, ranging all the way from $40 to $80 per acre, have been made. Production costs, except those for harvesting, should not be greatly different from those for potatoes. Harvesting costs for artichokes are higher than for potatoes. The removal of the tops is an additional item, and the tubers are smaller and more widely scattered through the soil. Although there has been insufficient experience to permit an estimate of costs, it seems clear that the crop will not be a very cheap one to grow, harvest, and handle.

CHAPTER XV

CELERY ENTERPRISE

Analysis into Jobs.—The jobs, or teaching units, in a celery enterprise are listed below. Forms for analyzing the jobs into problems may be found in other truck-crop enterprises. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with celery, 1269.
2. Choosing varieties, 1269.
3. Procuring seed; treating; testing, 1390.
4. Starting and managing plant beds, 1269.
5. Choosing soil; providing plant food, 1269.
6. Preparing soil; planting plants, 1269.
7. Cultivating the crop, 1269.
8. Controlling enemies and diseases, 463T.
9. Blanching the plants.
10. Harvesting; grading; packing.
11. Storing celery, 1471.
12. Marketing, 1144, 1551.

Job 1. Determining Possibilities with Celery

Suitable Areas.—The commercial growth of celery is largely restricted to areas where soil is particularly favorable. Rich, black muck soils are preferred for this crop. These areas are found near large lakes and in river bottoms and also in other special localities. Much of the early crop is shipped from southern regions, such as Florida. The climatic requirements are that the crop should have cool conditions for growth. This may be accomplished by having the crop grown in the cool season of the year if the climate is warm; but celery is very thrifty in central and northern latitudes where it is grown to maturity in the fall.

Available Markets.—Celery may be transported long distances to market. When the distances are great, the cost and shipping facilities should be taken into consideration. If the region is near a large market, the shipments may be made by auto trucks, but in this case good roads are necessary. There is less danger of overstocking the markets with this crop than with some other more perishable truck crops. Celery can be held and marketed gradually as the demands require.

Labor and Capital.—There is a rather large amount of labor involved in the growing, harvesting, and marketing of celery. A number of other truck crops require much less labor. Average celery growers seldom raise over ten acres, but large producers often greatly exceed this amount.

Capital for Investment.—The chief capital requirement is for plants, and if they are grown at home this need be no difficulty for a beginner. Cost of hotbeds, packing sheds, and storage cellars should be considered. The land investment is usually very great, as soils for celery must be very rich and the price per acre is usually high.

Insects and Diseases.—These enemies may give a little trouble with celery. Usually spraying is necessary, and this should be taken into consideration when this crop is being considered.

Competing Regions.—A grower should study what regions are marketing celery in the markets which he wishes to use. He should see if they are more favorable for the production of celery than his own region. He should see if his crop can be prepared in advance of the others. Local markets may be used to some extent. There are possibilities of catering to the special trade of hotels, restaurants, hospitals and sanitariums, which may demand a special quality.

Yields and Prices.—Successful crops usually range in yields from 500 to 750 small crates per acre. Each such crate may be expected to return to the grower \$1.50 to \$3.50.

Job 2. Choosing Varieties

Golden Plume and Easy Blanching are leading varieties. Other early varieties are Golden Self-Blanching and Green Top. A good late variety is Giant Pascal. Golden Self-Blanching and Golden Plume are less susceptible to celery diseases, and resistant strains have been developed.

Varieties Used Locally.—It is well to choose a variety which is already in use in the community. Communities should standardize on one variety or not more than two, and the growers in a region can help each other by marketing together. Grading and packing may be done more uniformly, and the shipping season is more uniform. Buyers are attracted, because they know they can get a good supply of one kind of product in that region. Improved farm practices are encouraged.

Job 3. Procuring Seed; Treating; Testing

Celery Seed.—Even the best celery seed has low germinating properties. The best seed should be secured from good, reliable dealers. Home-grown seed is usually out of the question.

Testing.—It is more important to test celery seed than most other

kinds of garden seed because of its low vitality. Methods of testing were described in the tomato enterprise. Be sure that the seed germinates well. It should reach as high as 75 per cent if possible.

Soaking Seed.—Celery seed is sometimes soaked before planting. It is best to use water at a temperature of 100 to 110 degrees for about eight to twelve hours. Celery seed is started with difficulty. If the temperature is maintained through the soaking period, germination takes place more readily.

Treating.—Celery seed should be treated to avoid introducing diseases into the soil. The corrosive sublimate described for other garden seeds may be used, and this may take the place of the soaking process already described. (See Chapter I.)

Job 4. Starting and Managing Plant Beds

Starting the Plants.—Sow seeds in flats or beds of fine soil which has been firmed somewhat. The seeds are very small and should be covered by sifting only a little soil over them. Keep them well watered but never soaked.

The early crop of celery should be started first; often it may be in January or February in northern states. Good management is required to succeed with manure hotbeds for such a long time. This is the reason so many growers prefer greenhouses for the best plants. Transplant seedlings when two inches high, setting them one to two inches apart. Some growers buy the plants from others who have greenhouses. May 1st is about as early as the plants should be set in the fields in most northern latitudes.

The late crop of celery should be started about March or April and be ready to set out in the field by the last of June. Great heat is not required for these beds, but a steady, uniform heat is desired. Avoid overheating and steaming beds with moisture and heat. The plants are likely to be badly attacked with damping-off disease. This trouble is common with celery plants in hotbeds. A temperature of about 50 degrees at night and of 70–80 in the daytime is best. The plants may be started in flats or may be shifted once from the beds to flats, and further shifting will be unnecessary. If the little plants are shifted to flats, these may soon be moved in favorable weather to cold frames where the plants will grow under cool conditions. They should have close attention and frequent watering.

Hardening Plants.—This is done by cooling the plants both night and day, a little more each day, toward the end of the forcing season before they are taken to the field. Reduction of watering will aid also.

On the first warm night the sashes may be left open all night. The hardening should be gradual and should be continued until the plants are hardened enough to stand the coldest nights after transplanting to the open garden. Recent experiments question the value of hardening (See Experiment Station reports.)

Job 5. Choosing Soil; Providing Plant Food

Celery Soils.—The celery crop demands special soils for its growth. Rich, black, muck soils, along river bottoms, in the beds of ancient lakes, or in drained lowlands, suit this crop well. These soils are of good texture and usually are moist and yield their nutrients well. If the climate is cool the crop thrives. Kalamazoo, Michigan, is the center of the great northern celery district. Similar soils are found in other northern states, in Florida, and in California. The drainage should be good. If water stands near the surface celery will not thrive.

Choosing the Field.—A good farm rotation should be planned by which the celery crop will follow a clover crop or some other crop which may be turned under for green manure. In northern states celery may follow clover or timothy in the regular field-crop rotation, provided the soil is otherwise suited to celery. Truck farmers find it best to select the crops to suit their soils.

The size of the field should not be large. Avoid growing larger fields than can be properly tended. Do not yield to the temptation to increase acreage greatly after a profitable year. Shortage of labor at transplanting and harvesting time may be a great stumbling-block if large areas are grown. There is always some danger of overproduction.

Plant Foods.—Commercial growers usually find it profitable to keep the soil well supplied with plenty of organic matter. This should be allowed to rot well and will provide the plant food necessary for the crop. In some cases, it is advisable to apply commercial fertilizers. The kinds needed will be indicated by the growth. If the tops are not of a good green color and are not leafy, it is an indication that the crop may need some nitrate of soda. If the soils are of the best types, this type of fertilizer should not be needed. Trials made by the Indiana station showed great value resulting from the use of potash fertilizers on muck soils. The use of 400 pounds of muriate of potash per acre doubled the yields. A greater yield resulted from the use of 1½ tons manure with 200 pounds muriate of potash per acre. The greatest yields came from the use of 450 pounds superphosphate with 400 pounds muriate of potash.

Soil Acidity.—Growers should test soils for acidity, as muck soils in some cases are rather acid. Celery thrives best if the soil shows no acidity. Lime should be applied to neutralize any acid present.

Job 6. Preparing Soil; Planting Plants

Frequent Harrowing.—The soil for celery should be prepared by deep plowing and frequent harrowing. The surface should be very mellow and loose at planting time.

Marking Rows.—The distance between celery rows depends upon the methods used in blanching the stems. For the banking method, the rows should be about four feet apart; but for the board and paper methods the rows may be three feet or even only two and one-half feet apart.

The rows may be marked with an ordinary marker or with a bull-tongue plow or lister.

Planting in trenches is a good practice which aids in the blanching of the mature crop. (Figs. 195, 196, 197.)

The plants are usually set at intervals of about six inches in the rows. This is usually done by hand methods.

Job 7. Cultivating the Crop

Implements.—In small gardens, if the rows are rather close together, wheel hoes are frequently used. These are less desirable when the rows are wide apart. Usually horse implements are used between the rows. Adjustable cultivators which can be made to suit the width of the rows are in common use. No cross-harrowing can be done.

Cultivation should begin as soon as the plants are set and should be frequent and shallow at first. Later on a great deal of soil may be moved toward the rows, at least as the crop is being "laid by." No weeds should be allowed to grow between the rows or in the rows.

Ridging.—Toward the end of the season, cultivation should be of such a character as to tend to hill or ridge the rows slightly.

Irrigation of Celery.—Where a high-priced crop like celery is grown on expensive land, irrigation is often practicable, though its cost may be rather high. Overhead systems of irrigation are sometimes installed and used for celery or for other truck crops.

Job 8. Controlling Enemies and Diseases

Celery Worms.—These larvæ sometimes attack the celery crop and are very serious. They eat the leaves and practically defoliate the plants when they are present in great numbers.

Control consists in spraying or dusting with arsenate of lead.

Late Celery Blight.—This disease sometimes destroys much or all of the crop. It is most common in regions not well suited to the growth of celery or under unfavorable weather conditions. Brown spots appear

on the leaves. These may unite, and the whole leaf is soon brown. Small black fruiting bodies appear later. The spores live over winter.

The chief preventive measures are to choose celery varieties or strains resistant to this disease. Soak seeds for one-half hour in water at a temperature of 115° to 120° F., or use corrosive sublimate treatment already described.

Spraying with Bordeaux mixture is most successful. Methods of making Bordeaux mixture are given in the apple enterprise. When leaf-eating insects and a celery disease are both present, or liable to be present, the two sprays should be combined. Bordeaux mixture may have arsenate of lead mixed with it as if the Bordeaux mixture were so much water; that is, use one pound of arsenate of lead in fifty gallons of Bordeaux mixture. This will combat both the disease and the insects at the same time.

Pithy Stalks.—Celery stems are sometimes pithy, unsuitable for food. The trouble is not a disease attack but is due to abnormal growth. It may be prevented by use of better seed stocks and strains of celery selected to prevent this type of growth. Thrifty, steady growth is said to help.

Running to Seed.—Stems of celery sometimes develop to form seed the first season instead of waiting until the second year. Such a growth ruins the plants. Proper selection of seed stocks is the best preventive measure. Long periods of dry weather followed by heavy rains may cause this condition as would carelessness in handling plants in frames. Irrigation at the proper time would cause better growth.

Job 9. Blanching the Plants

Need of Blanching.—Markets demand blanched celery. Green celery is bitter. Furthermore, blanching promotes the growth of celery "hearts" without green color in the center of the plant. Because of their rapid growth in the dark, these hearts are very tender and luscious. Blanching should begin with early celery some two or three weeks before harvesting. Green varieties require more time than others. There must be time for the green color to disappear from the stems. When growth is slow more time is required than when growth is rapid. Late celery needs more time for blanching unless it is to be stored.

Methods of Blanching.—Three common methods are in practice (Figs. 195, 196, and 197):

Boards are placed along the sides of the rows of celery, the boards being up on edge, and are held in place by stakes or by wire clamps. Sometimes wooden strips are nailed to the top edges of the boards to help hold them together. Some growers put leaves or other litter between the

Fig. 195.—Blanching celery by hilling up soil. (Illinois Station.)

Fig. 196.—Celery blanched with boards. (Lloyd's *Productive Vegetable Growing.*)

Fig. 197.—Blanching celery with heavy black paper. (Florida Station.)

boards to help keep out the light and to prevent the celery from freezing if harvesting is delayed until after heavy frost.

Banking with soil is less common than formerly. The dirt is thrown toward the plants by use of a plow; and when the crop is harvested the soil must be moved. The most serious objection to this method is that the stems are sometimes discolored and are often rotted, particularly if the weather is wet or otherwise unfavorable.

The paper method of blanching has recently been adopted by many growers. Black paper, about one foot wide, is supplied in rolls, mounted on wire reels. Fastening the paper at one end of the row on each side of the row, the operator moves along, rapidly unrolling the paper, which is held on edge by the use of wire wickets placed at suitable intervals to hold the paper closely against the plants and exclude the light. Heavy paper which is made for this purpose and does not affect the flavor of the plants, may be used for several seasons.

Ethylene gas is sometimes used in blanching celery in storage. This is a very quick method but does not tend to develop the celery "hearts" now so much desired. Few are very enthusiastic about this new method.

Job 10. Harvesting; Grading; Packing

When to Harvest.—For early markets celery should be harvested as soon as it is sufficiently blanched. The early crop sometimes brings a better price than the late crop. It is not uncommon, however, for prices to be highest in late fall, winter, and early spring. For the late crop, harvesting may be delayed until the winter weather requires that the crop be protected from heavy freezing.

Lifting the Plants.—All the plants in the row are harvested together. The plants are lifted with a plow; or the dirt is removed with a plow and the plants then pulled out by hand. Field crates or boxes are filled by hand and hauled to a packing shed or a coöperative packing house. Usually the trimming of the roots is done at the shed or packing house. Some celery is shipped "rough" as dug, and the trimming, washing, bunching and grading are done at the distributing point.

Grading.—The plants are washed in vats of water and then graded according to size. Usually three sizes are selected. Imperfect, pithy, or diseased plants and those too small for market are discarded. This may constitute as much as one-fourth of the crop. This, however, aids in maintaining a better price for the good celery.

Celery "hearts" are sometimes used to make up a special fancy grade of celery. They are often intended for special markets.

Packing.—The plants of uniform size and appearance are bunched together and tied with special tape, usually several plants make up a bunch. Bunches of the same grade are packed in crates together, and the number of bunches is stamped on the outside of each crate. Crates vary in size in different districts. Small crates are about 10 x 20 x 22 inches. Large crates are about 20 x 22 x 24 inches. Crates should be lined with paper but should also be light and open to facilitate handling and ventilation.

Job 11. Storing Celery

Reason for Storing.—Much of the celery crop grown in cold climates is stored for a period varying in length according to conditions. Storage was probably first started for the purpose of having a celery for home use all through the winter season. From the marketing point of view the chief purposes of storing celery are (1) to continue the blanching process; (2) to wait for prices to advance; (3) to prevent dumping too much on the market at harvest time; (4) to allow a more orderly and systematic supplying of market demands; (5) to provide a more even distribution of labor in trimming, washing, bunching, grading, packing, hauling, and marketing the crop.

Storage Conditions.—Celery must be kept at a low temperature. If the air is at 32 degrees F. or only a little above, the product will keep well. It should never be frozen. The plants to be stored should be handled carefully to avoid injury. No diseased plants should be placed in storage. The leaves and stems should not be wet.

Methods of Storing.—Several good plans for storage of celery are in use in different regions: (1) in field trenches; (2) in temporary dugouts or pits; (3) in permanent cellars and houses; (4) in cold-storage plants.

Trenches in the open garden are made as deep as the height of the plants will require. The plants are set close together in the deep trenches and covered with boards. A trench may be wide enough to have several rows set close together. In this plan the roof is wider.

Temporary Dugouts or Pits.—If much celery is to be held until mid-winter a large dugout or pit is much more convenient than a field trench. A space may be left in which to work in preparing and packing the product for market. The temperature is more easily controlled in such a place than in a trench. Pits are often of temporary character and rebuilt each year.

The celery is placed closely in rows, and the rows are a few inches apart with soil packed about the roots to support the plants. Self-blanching types of celery seldom keep as well as the green types.

Celery Houses.—Special houses of permanent construction may be

in the form of modified cellars or pits. They are often similar to potato or root houses, partly below ground. Such permanent places of storage must be thoroughly cleaned and disinfected every season. Celery may be stored as described in the pits. In some cases crates are used in which to store the plants. Light is excluded from the storage room, but a work space may be temporarily lighted when men are preparing celery for market.

Cold Storage.—This plan of holding celery is growing in popularity. Temperature and moisture conditions are more perfectly controlled. Trimming, washing, grading, bunching, and crating are done before the product is placed in cold storage. Small crates are preferred for this purpose. If such storage plants are well located by railway tracks the crates may be loaded into cars in all kinds of weather and the product may be marketed as desired.

Job 12. Marketing

Coöperative Selling.—In recent years much of the celery crop in the intensive celery districts is marketed through coöperative associations. The association attends to proper grading and packing of the crop. Packing materials and crates are often bought coöperatively. The association may own a good packing house or suitable place for washing, handling, grading, and labeling the crop. The best markets are located, and buyers are often invited to come and bid on the crop and buy it f. o. b. the cars. The crop may be sold by the association in the field or at the point of delivery. Money is sometimes borrowed from the association on the crop to aid in harvesting and marketing. Returns are made to the association as rapidly as the crop is sold.

Direct Selling.—A very large part of the northern grown celery is trucked to market—100-mile hauls not being uncommon. Much of the product so handled is sold by growers directly to hotels, restaurants, hospitals, sanitariums, and local dealers such as chain stores.

CHAPTER XVI

LETTUCE ENTERPRISE

Analysis into Jobs.—The farm jobs or teaching units in an enterprise with head lettuce, leaf lettuce, and cos lettuce or romaine are listed below. Forms for analysis into problems are found in other truck-crop enterprises. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with lettuce, 937, 1044, 1418.
2. Choosing the type and the variety.
3. Procuring good seed; testing; treating, 1390.
4. Starting plants in beds, 1418.
5. Choosing soil and field; providing plant food.
6. Preparing soil; planting plants.
7. Cultivating and caring for the crop.
8. Controlling enemies, 1371.
9. Harvesting; grading; packing.
10. Marketing, 1144, 1551.
11. Forcing lettuce, 1418.

Job 1. Determining Possibilities with Lettuce

Conditions for Success.—Head lettuce is usually started under glass, or at least in coldframes, where the plants will make an early start and can be transplanted later to the open garden. Transplanting seems to encourage the heading of head lettuce.

Leaf lettuce is grown in the open and does not need transplanting.

Romaine or cos lettuce is also often transplanted from hotbeds or coldframes to the open garden.

All of these crops endure very cool weather and thrive best under cool conditions. Romaine or cos lettuce will stand more heat in summer than the other types of lettuce and is, therefore, more popular than the other forms of lettuce in some southern regions.

For the best success with lettuce cool weather and cool regions such as are found in central and northern latitudes are desirable. Hot weather is likely to cause trouble such as tip burn, and it also tends to make the plants run up to seed instead of forming good products. The flavor is apt to be bitter if the weather is hot, particularly if it is also dry.

Labor Involved.—Leaf lettuce requires no more labor for growth than crops of greens which are sown broadcast or drilled in rows. Transplanting is not the practice for leaf lettuce except under special conditions.

Head lettuce and cos lettuce require much more labor and may be

compared, in this respect, with early cabbage. Each head of lettuce usually brings a price somewhat lower than each head of early cabbage, but the price is more apt to be stable year by year, and the number of plants per acre is much greater. Perhaps two or two and one-half times as many plants per acre may be grown.

Lettuce is also grown as a companion crop, very successfully. Grown with crops which mature later it receives care and cultivation at the same time and is harvested before the other crops need the room. In figure 198 it is shown growing with cauliflower.

FIG. 198.—Companion cropping with lettuce and cauliflower. A good combination for small gardens. (Cornell Reading Circle Leaflet.)

Job 2. Choosing the Type and the Variety

Varieties of Leaf Lettuce.—Leaf lettuce is widely grown in home gardens and somewhat in commercial gardens.

Grand Rapids is one of the handsomest varieties of curled or loose leaf lettuce. It makes a quick growth, is hardy, and holds its crispness for days after being cut. Compact clusters are produced, but no true heads.

Black Seeded Simpson is a standard old variety of leaf lettuce. It is believed to be a little more heat-resistant than the Grand Rapids. The clusters are more open and there is less tendency to form a head.

Early Curled Simpson is a loose leaf variety which may be cut very

young. The clusters are in loose heads. This variety is adapted for sowing thickly in rows and cutting when young.

Varieties of Head Lettuce.—Big Boston is a standard old variety of head lettuce (Fig. 199). The leaves have smooth margins. It has been improved greatly in recent years and is constantly gaining in popularity. This variety is particularly suited to northern and north-central climates. The heads are extra large, firm, and solid. The hearts are crisp and well blanched.

Cabbage lettuce is perhaps one of the best all-purpose head-lettuce varieties. The heads are rather large, solid, and well blanched at the

FIG. 199.—Boston head lettuce. Section showing solid texture and light color which help make the finest quality. (Cornell Reading Circle Leaflet.)

centers. It seems to stand a little more warm weather without running to seed than some other varieties.

Among the smaller headed varieties are Iceberg, Improved Hanson, and Summer Allheart. These three varieties are considered among the best for central and southern latitudes, where larger varieties of head lettuce will not head well. Another which might be added to this group is California Cream Butter.

Cos Lettuce or Romaine.—This is also called celery lettuce. It has high quality, is long and slender in shape, and heads well. The central part blanches nicely, and the stems resemble celery somewhat. It is often considered summer lettuce as it stands more heat than any of the other types. This variety has gained in popularity rapidly in recent years. Its taste and appearance differ greatly from those of other varieties of head lettuce.

Job 3. Procuring Good Seed; Testing; Treating

Fresh Seed.—It is usually easy to procure good fresh seed from reliable seedsmen. It is not difficult for gardeners to produce their own seed, as varieties will readily send up seed stalks and produce seed in warm weather. Some birds are very fond of seed and may scatter a great deal of the seed before it is gathered unless care is taken to prevent this. Lettuce comes true to variety very well as little crossing takes place. The cost of seed is so low that home gardeners seldom save their own seed.

Testing Seed.—Review the arguments in favor of testing seed as given in the tomato enterprise. Old lots of lettuce seed are liable to low germination, and should be tested before planting. The cost of labor for testing is very slight and should pay for this, as well as for other garden seed.

Treating Seed.—Lettuce seed, as well as other types of garden seed, should be treated before planting to avoid introducing diseases into forcing beds or into the garden. Simple methods of treating seed are given in the introductory chapter.

Job 4. Starting Plants in Beds

Leaf Lettuce.—The different varieties of leaf lettuce may be started in hotbeds or cold-frames if desired; but, as they are very hardy and do not need to be transplanted to make them head, their seed may be sown broadcast or drilled in rows in open gardens. Some varieties which form dense clusters but no true heads are sometimes started in beds and transplanted to the open garden.

Starting Beds for Head Lettuce.—The seed should be planted in cold-frames by the first of March or a little earlier. As soon as the plants have formed their second pairs of leaves, they may be pricked out and transplanted into flats to remain until they are ready to be transplanted to the open garden.

Seed may be sown in the beds or in flats, broadcast and packed into the soil slightly, with a little soil sprinkled over the top. A very little cover of soil is necessary for germination. They may be watered well and perhaps covered with paper to keep the moisture from evaporating and crusting the soil. This is not necessary if the soil is somewhat sandy.

Beds should be started for head lettuce about six weeks before the plants are to be set in the open garden. The crop is very hardy and may be transplanted to the garden by the first of April even in northern climates,—perhaps April 15 in late springs (Fig. 200).

Beds should be kept very cool and well watered. Plenty of moisture and cool conditions are necessary for the successful growth of head let-

tuce. A steaming hot condition in the beds is very likely to cause damping-off fungus to start. When this trouble starts, the crop is likely to be taken quickly. Extreme changes in dryness and moisture are apt to cause trouble also.

Hardening is very essential before the plants are moved to the open garden. (See cabbage enterprise.)

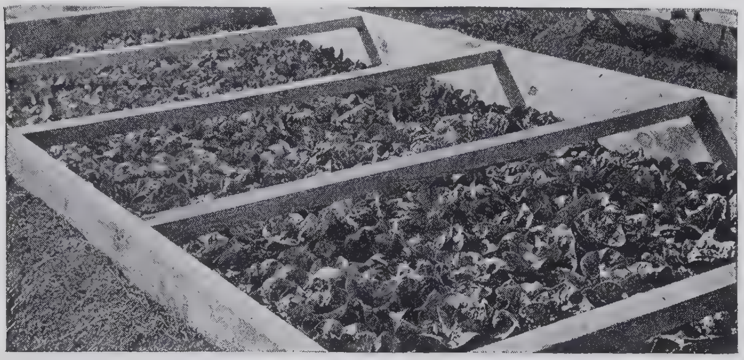


FIG. 200.—Head lettuce may be transplanted early into the garden. (Ohio Station.)

Job 5. Choosing Soil and Field; Providing Plant Food

Fertile Soil.—For the best quality of lettuce quick growth is necessary. The lettuce must be tender when ready for use. This means that a rich soil should be provided. Plenty of water should be present, and soil which will hold moisture well adds much to the growth. Crisp and tender heads cannot be produced on poor soil. Rich, well drained, black, sandy loams are ideal for the growth of lettuce. There should be enough organic matter present to hold moisture well.

Providing Plant Food.—For large or small lettuce fields apply plenty of green manure in the form of clover or other crops turned under when the soil is being prepared. Barnyard manure may be substituted and is a good form in which to apply plant food. Gardeners often make compost heaps of the manure in layers with sod. After this has rotted for a few months, it is turned and soon spread on the field for such crops as lettuce. Such a compost heap will rot the organic matter and make it more pliable for use in beds or fields where a fine soil is desired. Commercial fertilizers are often used for this crop.

Job 6. Preparing Soil; Planting Plants

Preparing the Field.—Where large areas of lettuce are to be grown for market the soil should be plowed the preceding fall; for the crop is to be started early in the spring, and little time is then available for preparing the soil.

When soil is plowed in the fall, it is a good plan to turn under the green-manure crop or barnyard manure so that it will be well decayed or settled by the time the soil is to be finished for planting in the spring. The following spring the soil should be thoroughly disked and harrowed once or more with a smoothing harrow to put the surface in a fine condition. Before setting the plants, planking the surface will aid in putting it in good shape for marking off the rows.

The rows may be marked off at distances to suit the plan of cultivation to be followed. In small areas the rows are sometimes set as close together as 14 to 18 inches. In larger fields, it is common to have two or two and one-half feet between the rows. If the marker makes a very slight opening in the soil, that is sufficient for planting head lettuce.

Setting Plants.—The plants should be well watered before they are taken from the forcing beds and should be kept moist during the transplanting operation. Select a very damp condition, if possible, but avoid having sticky soil for the work. The lettuce leaves will wilt badly unless the conditions are moist and unless the weather is favorable. Avoid hot, windy days for this work. Cloudy days or evening hours may be chosen.

Large varieties of head lettuce are set at intervals of about eight or ten inches, and the smaller varieties are set a little closer. Hand methods of setting are most common. Machine planters are, however, sometimes used where they are available and large areas are to be planted.

Watering with machine planters is easily managed; but watering by the hand methods is more difficult. Sometimes, if the soil conditions require it, barrels of water are hauled along in a cart, and streams of water are run along rows. Overhead irrigation systems are sometimes used.

Job 7. Cultivating and Caring for the Crop

Thorough Tillage.—The lettuce crop should have thorough cultivation from the very beginning. Stimulate growth as rapidly as possible; allow no weeds which would interfere with the growth to appear; practise frequent shallow cultivation between the rows. If the rows are close together, hand tillage machines may be used (Fig. 201) and if the rows are two or two and one-half feet apart, horse cultivators may well be used. Tillage implements adjustable to suit the width between rows may be employed to good advantage.

Moisture.—Lettuce requires plenty of water. If the weather is dry, artificial watering is often advisable. Some successful growers plan overhead irrigation systems for the purpose of forcing the growth of lettuce continuously.

Screening or Shading.—Some growers have devised plans for

artificial shading or screening of lettuce fields. The crop grows well under partial shade. Light structures of various kinds have been devised for shading rows of lettuce. Whether this will pay or not depends upon the market prices which are likely to be secured for the crop. Most growers have found that the choosing of suitable varieties for their conditions pays better than constructing artificial shade for lettuce. Natural shade may sometimes be secured by planting the crop on the east side

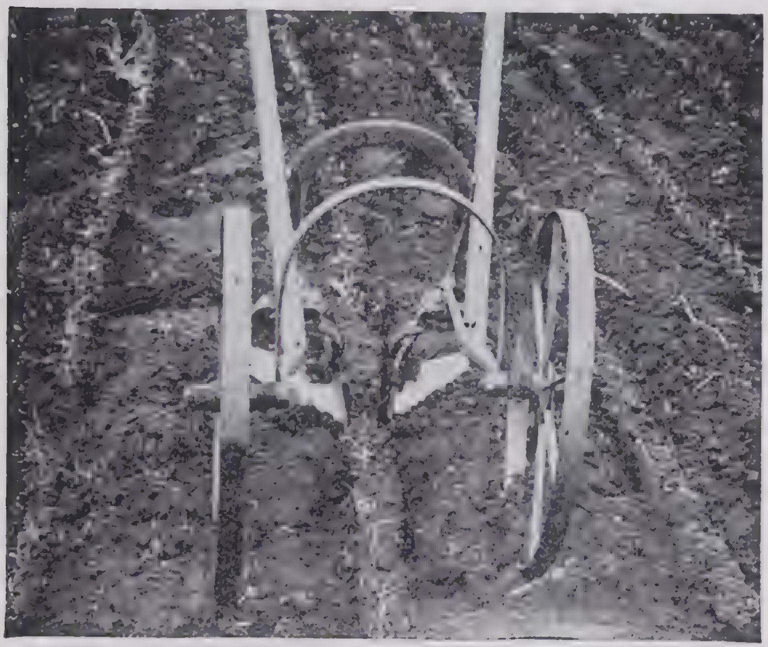


FIG. 201.—A double-wheel hoe may save much hand weeding in gardens. (Indiana Station.)

of a wood-lot or windbreak where the trees will shade the plants during the hot afternoon hours. This has the objection of allowing the roots of the trees to rob the soil of the moisture. A trench may be cut along the line of trees to cut off the tree roots and prevent this robbing of moisture. Thus partial shade during the hot part of the day may be secured without the moisture being lost through the tree roots.

Cos Lettuce.—This crop is often grown for market. The leaves are more erect than other varieties of lettuce. To induce blanching of the inner parts the leaves are tied together at the top, very much as with cauliflower. Some varieties of cos lettuce tend to blanch their own hearts

well; the outer leaves grow upright and remain close together. In these strains tying may be unnecessary.

Job 8. Controlling Enemies

Lettuce Drop.—This disease will ruin lettuce in a few days. It develops during warm, moist weather, causing a rotting of the plant. Starting the plants in sterilized soil, rotation, and careful watering are methods for its prevention.

Damping-off Fungus.—This trouble starts in hotbeds which are not properly regulated. The disease eats off the plants on top of the ground, and in some cases the entire crop is ruined. Favorable conditions for healthy growth were discussed in Job 4. Seed should be treated with Semesan, one teaspoonful in a quart of water. Soak for 30 minutes. Avoid too heavy watering at one time. Avoid, also, having the beds too hot or too dry at any time. Steady, healthy growth is the best remedy against this trouble. There should not be too much rotting organic matter in the soil of the hotbeds. After the plants have been transplanted, they should be taken to a cold-frame or to a cooler bed where the temperature may be kept low even in the warm hours of midday. When the disease starts, it is well to move the plants which are not yet affected out of the bed.

Tip Burn.—This may not be a true fungous disease, but the plants are often affected with a brown tinge around the edges of the leaves when hot weather comes on. The best remedy is to keep the plants well watered and in thrifty condition for steady, rapid growth. If the crop is being greatly affected by the disease, it should be harvested as rapidly as possible. If not mature enough for harvesting, the crop may be watered or shaded to stop the burn.

Leaf Insects.—There are several forms of leaf insects which sometimes attack lettuce but are not particularly confined to the lettuce crop. These are not easily controlled, as spraying and dusting with lead poisons are not suitable for a salad crop. If the insects are very abundant, dusting with hellebore may be practised.

Job 9. Harvesting; Grading; Packing

Leaf Lettuce.—This product is cut or pulled as desired when it is large enough. For home use, the early thinnings are pulled as soon as the leaves are large enough for use. For market, large bunches should be formed before harvest time. Usually the whole plant is cut at the top of the ground or is pulled by the roots. The roots are cut just below the cluster of leaves, and the product is packed somewhat as in the case

of greens for market. For home use the leaves may be cut off above the crown of the plant, which will then grow up again forming a second crop.

Head Lettuce.—When heads of this crop are well formed or the hearts are blanched, the mature plants are pulled and the long roots cut off. The best time to harvest is in the early morning when the heads are full of moisture accumulated during the night. Avoid taking the heads when they are wilted by the heat of the day.

Grading and Packing.—Heads of lettuce are sorted according to size. The small inferior plants and those which have not formed heads well should be eliminated. Packing is done in loose open crates. Sometimes hampers are used for the shipment of head lettuce. Avoid having the lettuce wet with water at the time of packing. Plenty of moisture in the plants but none outside of them should be the rule.

Job 10. Marketing

Freshness.—Lettuce products should reach the market in as fresh a condition as possible. When head lettuce or leaf lettuce is displayed in market, it should be fresh and crisp. The product is often freshly washed or immersed in water for a few minutes just before being displayed in market windows. Sometimes a sprinkler is used in watering the lettuce in window trays. A spray, kept running, may often be very attractive to the buyer.

Securing a Market.—The rules and suggestions given in other truck-crop enterprises for the securing of suitable markets, apply well to this crop. There is much danger of overproduction at certain seasons of the year for the marketing of lettuce. City markets will consume large quantities of lettuce if it is put before the buyers in an attractive form. One of the chief advantages in coöperation is the finding of suitable markets which are not glutted or inclined to be overstocked.

Job 11. Forcing Lettuce

Forcing Lettuce.—Leaf lettuce has lost much popularity in recent years, as the head lettuce from different parts of the country has been on the market almost every day of the year. However, homegrown products are always in demand to a limited extent and where a market can be built up, leaf lettuce can be profitably forced.

Leaf lettuce is the profitable midwinter vegetable crop, adapting itself to cloudy weather and cool houses, but requiring a deep, well-drained soil and liberal quantities of moisture. Excessive liming is dangerous.

Varieties and Seeding.—The common forcing variety of lettuce is

Grand Rapids, though Salamander, May King, and Simpson have been used. The seed are sown in flats and transplanted when large enough to handle easily. They are usually set 2 by 2 inches in the flats and set into the beds from these flats. For the fall crop about 10 weeks are required from seed to harvest, while the winter crop may require 14 weeks.

Culture.—The seedlings are set 7 by 7 inches to 9 by 9 inches in beds and are grown at a night temperature of 45° to 50° F. It is important that the crop be kept growing actively to insure a tender, crisp leaf at harvest. It is also necessary that the air should never get muggy, as diseases are very apt to become established if there is an absence of fresh air. The crop requires large quantities of water which may be applied by the hose, from overhead sprinklers, or through tiles under the ground.

Harvesting and Packing.—The heads may be cut at any time. The longer they are allowed to remain in the beds the larger they will be. When a seed stalk begins to grow, the lettuce becomes bitter. In harvesting, the entire plant is cut off at the ground; the broken, poorly colored, and dirty leaves are removed, and the plants put into baskets or boxes holding 5 pounds. Unless refrigerated, lettuce does not ship well. Do not wash lettuce before selling unless it is very dirty, as it will not keep well if packed wet.

Insects and Diseases.—The aphid, which is controlled by tobacco fumigation, is the only insect of importance to the forced lettuce crop. Lettuce drop, a soil-borne disease, causes considerable loss each year to greenhouse lettuce. It cannot be controlled if it gets a start in a bed. Soil sterilization is the only satisfactory means of preventing it.

Where to Grow.—While lettuce is usually forced in greenhouses, an early-winter or a late-spring crop can often be profitably produced in electrically- or flue-heated hotbeds.

CHAPTER XVII

COLE CROP ENTERPRISES

Analysis into Jobs.—Following is a list of the managerial and operative jobs or teaching units in enterprises with cabbage and cauliflower and their close relatives, kohlrabi, broccoli, Brussels sprouts, collards, and pe-tsai (Chinese cabbage). Forms for analyzing the jobs into problems are given in other truck-crop enterprises. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with one of these crops, 252C.
2. Choosing the type of crop and variety, 169MP, 433.
3. Procuring good seed; treating; testing, 311DC.
4. Growing plants in beds; hardening plants, 1743.
5. Choosing field; providing plant food, 433.
6. Preparing soil; setting plants, 252C.
7. Cultivating and caring for the crop, 252C.
8. Controlling enemies, 181T, 1029D, 1371F, 1439F.
9. Harvesting, grading, and packing, 1423.
10. Storing for winter, 879.
11. Marketing and using, 1242D, 1423, 1480Y, 1579F.

Job 1. Determining Possibilities with One of These Crops

Regions.—Both early and late cabbage are best adapted to regions where the climate is cool. Cauliflower also grows best under cool conditions. Northern and central latitudes are much better for these crops than southern regions. California is the leading state for winter growth of cauliflower; and New York is the leading state for the fall crop. Late cabbage makes its principal growth during the cool weather of the fall, while early cabbage and cauliflower make their best growth during the cool weather of early spring. Early cabbage is an important crop in Florida, Texas, South Carolina, Virginia, and other southern states, where it is grown in the cooler seasons.

Labor and Capital.—There is a great amount of labor involved in the growing of these crops as compared with the selling value of each head of cabbage or cauliflower. Transplanting is usually practised.

Spraying for insects and diseases is usually necessary. The labor of harvesting must be considered.

There is little additional expense over other truck crops for growing cabbage and cauliflower. Plants can be readily produced at home. The seed is inexpensive. The investment per acre need not deter a beginner from undertaking an enterprise with one of these crops.

Markets.—The danger of overproduction is always to be considered. Many cabbage and cauliflower crops have been produced which could not be marketed because of an overproduction at the time. Experienced growers should be consulted regarding the dangers of overstocking the available markets. Some gardeners practise growing one of these crops when markets the preceding year were overstocked. Many inexperienced growers are quickly discouraged by poor markets and will not grow any crop the next year; this leaves the markets free for those who persist in growing the crop regularly each year.

Fig. 202

Fig. 203

Fig. 202.—Allhead is a rather early variety but has the broad, flat form of later varieties. (Ohio Station.)

Fig. 203.—Typical form of the earliest varieties of cabbage.—Early Jersey Wakefield. (Ohio Station.)

Job 2. Choosing the Type of Crop and Variety

Two Main Crops.—Early cabbage is grown for early market and is usually sold as soon as the heads are large enough. The price per pound for this product is much greater than for late cabbage.

The late cabbage crop is usually stored or sold to a kraut factory.

There are really two crops of cauliflower, but early cauliflower is much more popular than the late. The demand for the early crop is

usually good in large markets. A full crop of early cauliflower is sometimes grown in the cool weather of autumn.

Varieties.—*Cabbage:* Northern cabbage growers use Copenhagen Market and Golden Acre for early market. They are round-headed varieties. Early market varieties of cabbage for shipping long distances are Jersey Wakefield, and Charleston Wakefield. Early Wakefield varieties have small and rather pointed heads (Fig. 203). Later varieties are Succession, All Season, and Allhead (Fig. 202). Late varieties are Flat Dutch, Danish Ballhead, and Drum Head. Three types of late cabbage are grown: the common white, Savoy or curled, and red cabbage. White varieties are much more popular than the others, but curled cabbage is considered of higher quality. The disease known as cabbage yellows is controlled by choosing strains of cabbage which are resistant to this disease.

Cauliflower: Early varieties of cauliflower are Dwarf Erfurt and Early Snowball. Autumn Giant is a good late variety of cauliflower.

Job 3. Procuring Good Seed; Treating; Testing

Good Seed.—Seed dealers usually handle good seed of these crops. The vitality of seed is much reduced by age. It pays to have fresh lots of seed for planting.

Testing.—As cabbage and cauliflower seed are dark in color, it is difficult to tell the age by any means other than testing. It pays to test a few of the seed of each lot to determine the germinating power. The cost is slight and the results are often very beneficial. (See tomato enterprise.)

Treating Seed.—These crops are subject to diseases which may be introduced in the soil by planting contaminated seed. All the seed should be treated with hot water before planting. The seed may be soaked in a cloth bag. The hot water should be maintained at a temperature of 122° F. during the soaking treatment. Cabbage and Brussels sprouts should be soaked 25 minutes, and cauliflower seed 18 minutes. The hot-water treatment is safer than chemicals and in other ways much better. Growers find mercury very satisfactory for fungous diseases, but not for virus. See mercury treatment in another chapter.

Job 4. Growing Plants in Beds; Hardening Plants

Early Plants.—To succeed with early cabbage or early cauliflower, plants may be started in hotbeds or cold-frames early in the season (Fig. 164). They can stand very cool weather and may be started as early as February or March so that the plants will be ready to transplant to the open garden as soon as the ground stops freezing. Cold-frames are usually

suitable for this purpose, as little heat is necessary. The heat trapped by the glass covers of the hot beds should be sufficient for the starting of the seed of this crop.

It is usually unnecessary to transplant or shift the plants in the beds more than once. The seed may be sown in flats (Fig. 204). The frames should be well ventilated and thoroughly watered. Avoid allowing extreme heat in the beds during warm sunny days.

In the South and Southwest, and some other sections, seed is sown in outdoor beds in the fall. The plants are very hardy and are often shipped to other sections. Late varieties are grown outdoors in northern sections.

Fig. 204.—Seed should be treated before planting to avoid seed-borne diseases. A flat of young early cabbage plants one week after transplanting. (Illinois Station.)

Hardening Plants.—This step is very important if the plants are to be set in the garden very early and may be subjected to frost on a number of cool nights. The hotbeds or cold-frames should be opened on warm days, and when the nights are not too cool the glass may be left off or may be left slightly open, according to the temperature. Withhold water during this period. Too long hardening is not desirable; a week or two is enough. When the plants are thoroughly hardened, the leaves will show a pink or blue tinge. The plants should then be able to withstand several degrees of freezing in the garden after transplanting. Hardening must be very carefully done.

Job 5. Choosing Field; Providing Plant Food

Rich Soil.—It is difficult to have soil too rich for cabbage. Heavy black muck soils produce large yields. Rich, well-drained garden soils of any kind produce satisfactory growth. Rich sandy loams are desirable for early crops in the northern regions.

Adding Plant Food.—The organic matter in soils for these crops should be well rotted. A green-manure crop of clover or other leguminous plants may be turned under in the fall and allowed to decay and settle until planting time the following spring. Barnyard manure may be added to loose soils in large quantities with beneficial results. Heavy applications of organic matter are most desirable on sandy loam soils.

Liming.—Cabbage or cauliflower thrive best on soils which are limed the year the crop is planted. Lime will help if the soil is sour and aid in the decay of organic matter turned under for these crops. It also aids in the liberation of plant food from sour soils, and as these crops are ravenous feeders, the growth will be greatly increased. Lime is a material which checks the development of club root, but it is not a very satisfactory control method.

Job 6. Preparing Soil; Setting Plants

Early Preparation.—For the early market crops of cabbage and cauliflower, early preparation is very important. The soil should be plowed the preceding fall if possible. It may be disked in early spring and harrowed several times to prepare a fine surface. Planking before marking off the rows will help. The rows may be marked with a garden marker set for the early crops at distances of about two and one-half feet.

Late Preparation.—For late cabbage and late cauliflower, the soil need not be plowed until spring. A cover-crop may be plowed under at that time as green manure if desired. There should be time before the planting of the late crops for a bare-fallow period during which the soil is disked or harrowed several times. This may destroy many of the weeds. The rows for late cabbage and cauliflower are usually three feet apart. Later cultivating is then reduced to a minimum.

Setting Plants.—Large fields are commonly set with machine planters. Cabbage and cauliflower plants stand transplanting readily. Before the plants are pulled from the beds, they should be heavily watered and can then be drawn by hand as desired. Plants in the rows for the small early varieties are set at intervals of 14 to 18 inches. Close setting makes small heads, such as are desired for early market. Late varieties are set farther apart, usually about 18 to 24 inches or more between plants. Large flat varieties grown for kraut are set three feet apart.

Hand methods of planting are used where machines are unavailable or where fields or gardens are small. Plants should be set a little deeper in the soil than they grow in the plant bed.

Protection and Watering.—If weather is not favorable for transplanting, protection of plants may be necessary and practical in small

gardens. (See tomato enterprise.) Machines usually water the plants at setting time. Hand watering is expensive and seldom pays if fields are large.

Job 7. Cultivating and Caring for the Crop

Shallow Tillage.—As soon as the transplanted plants have revived, cultivation should begin. Have the teeth of the cultivator small and run close to the rows. Stir the soil to keep it well mulched from the very beginning to avoid the growth of weeds. Avoid having cloddy soil and allow no weeds to grow. Cabbage and cauliflower should make rapid steady growth during the whole season, and should never be stunted by weeds.

Blanching Cauliflower.—When the heads of cauliflower have formed or are forming satisfactorily, the outer leaves should be tied over the heads to cause blanching and prevent sunburn. The heads complete their development in this darkened condition and remain white and attractive. If the leaves are tied too close, injury may result. Leave plenty of room for growth of heads.

Checking Late Cabbage.—Heads of late cabbage often burst because of rapid growth and are then unmarketable. Growth may be checked by bending the plants over to one side and thus loosening some of the roots. This will check growth enough to prevent bursting and the heads may be harvested when desired.

Job 8. Controlling Enemies

Cabbage Worms.—These are probably the worst enemies of cabbage, cauliflower and related crops. The larvæ are green worms which eat the leaves and may completely ruin the crop. Several broods are likely to occur during the summer. The pupæ formed by the worms hang on the under sides of the leaves and soon hatch into white butterflies which in turn lay more eggs within a few days.

Before the cabbage heads begin to form, the leaves should be sprayed or dusted with arsenate of lead. As worms are all killed before heads form, no danger will result. Some poison can be dusted on the heads if necessary, as the outer leaves are stripped off and poison will not get into the heads.

Clubroot.—This is sometimes called finger-and-toe disease. Affected plants show slight wilting at first, then swelling of the roots, sometimes very large. Growth of feeding roots is restricted. Attacks often occur in plant beds, giving plants a sickly appearance.

The organisms live over winter in the soil and thrive in acid soils.

For this reason soils should be limed to help keep this disease in check. Liming some months in advance of planting is recommended. Choose uninfected soils for plant beds and fields for these crops. The disease may affect cabbage, cauliflower, Brussels sprouts, mustard, radish, turnip, and rutabaga. Avoid planting in fields where these crops have been affected by clubroot disease.

Root-Knot Nematodes.—This trouble is similar to clubroot, but the swellings of the roots are not so large and are likely to occur farther out on the lateral roots. Pearly white bodies may be seen by opening the swellings. These are female eel-worms or nematodes. This trouble is most common in sandy soils of warm climates. The cabbage group of plants is most susceptible.

Control is best accomplished by rotation of crops so as to have two or three years of cultivated crops intervene before the cabbage crops are grown on the same field again.

Black-Leg.—This is a very destructive disease when present in cabbage, cauliflower, and Brussels sprouts. Long Island is the chief center of infection. Spots are produced on the leaves and stems, and the stem and main roots are rotted from the surface of the soil downward. The progress of the rot is usually slow, and it may linger through the entire summer.

Treatment—Spores of the disease live on seeds and in the soil for several years. A partly resistant strain of Brussels sprouts has been discovered. Treating seed with hot water has been found effective, but soaking or dusting with chemicals is less useful. The hot-water treatment consists in soaking seeds of cabbage and Brussels sprouts before planting in water at a temperature of 122 degrees F. for 25 minutes. Cauliflower seed is not believed to carry the disease. If it is treated the time should be only 18 minutes. (See U. S. D. A. publication no. 311DC.)

Avoid planting seeds or plants in an old infected seed bed or field area. Select soils which have not grown any of these crops for five or six years. Treatment of seed is very helpful. The hot-water method is probably best.

Black-Rot Treatment.—This disease prevails over wide areas. The treatments are practically the same as those given for black-leg.

Wilt or Yellows.—The name "yellows" is given to the wilt disease because of the color of the plants when badly attacked. Wilt is a good descriptive term also. Cut stems are dark and seem water-soaked. These crops are seriously affected in many regions where this disease prevails. Lower leaves drop off and plants may soon die. Varieties resistant to wilt have been well established and are listed in seed catalogs. They

should always be used in regions where the disease prevails. Treating seed is also recommended.

Black Rot.—This is noted by the blackening of the ribs of leaves, and of the tissue under the skin of the stem. Heads are dwarfed and one-sided, and often rot.

Black rot and black-leg are largely controlled by treating seeds with Semesan before planting, as these diseases are borne on the seeds. Avoid using soils and manures which are likely to be infected.

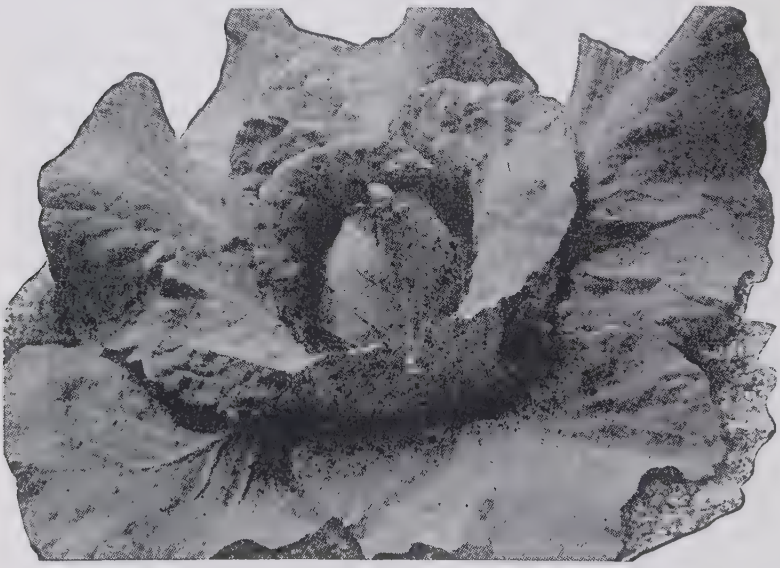


Fig. 205.—Early Jersey Wakefield cabbage. (Courtesy of W. Atlee Burpee Co.)

Whiptail.—Cauliflower is often badly affected by this disease, which prevents the formation of heads. Plants are dwarfed and sometimes cull heads are formed.

The trouble is caused by unfavorable soil conditions. Liming is recommended. Manure is to be used in preference to much commercial fertilizer when this disease is prevalent.

Job 9. Harvesting, Grading, and Packing

Judging Maturity.—The proper time for cutting heads of early cauliflower is when they reach full size. Do not wait until the heads begin to break. The grower may part the leaves which were tied together

for blanching and examine each head quickly. Heads develop rapidly and overgrowth may occur before it is noticed.

Maturity of early cabbage is judged by feeling the heads. Mature heads should be firm and resist pressure with the fingers. Size will be a guide if combined with tension of the surface leaves of the head (Fig. 206).

Harvesting.—The early crops should be harvested as soon as maturity will warrant, as prices are usually better early in the season. Early cabbage heads may be cut just above the outer leaves and placed in crates for hauling to the packing shed. Cauliflower heads are either pulled from the soil or cut at the top of the stem.

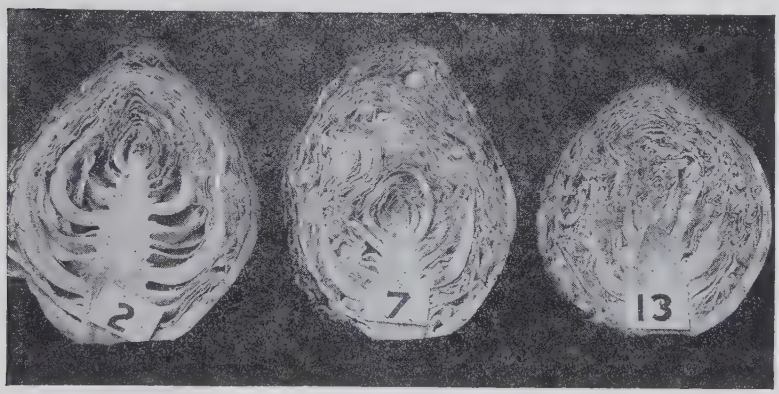


Fig. 206.—A good cabbage head should be well filled and will then feel solid. The one at the left is not fit for market. (Lloyd's *Productive Vegetable Growing*.)

Trimming.—The small early cabbage and cauliflower heads are usually trimmed to suit the particular market. Close trimming of cabbage is usually practised, but some markets require that a few loose leaves be left around the heads. If the shipping distance is great, a few loose leaves will aid in protecting the heads during shipment.

Different methods of trimming heads of cauliflower are practised for different markets. If the markets are distant, several of the leaves are left entire to protect the blanched heads during shipment. In other cases, leaves are trimmed with shears or knife a little above the top of the head, to protect it against bruising (Fig. 208).

Late cabbage, when shipped to market, is usually trimmed close to the head. In some cases, however, a few loose leaves are left for protection.

Packing.—Cauliflower and cabbage are usually packed in open slat crates or barrels. Round-bottom stave hamper baskets are often used for the earliest shipments. There is danger of heads heating if they are packed in barrels or crates without good ventilation.

Job 10. Storing for Winter

Holding Cabbage.—The late crop of cabbage is usually harvested about the time the ground freezes. The supply of this product is so abundant as to cause prices to be very low. Many growers find it profitable to store the crop for sale at a later date. Several methods of storing are in use, such as cellars, dugouts, and insulated houses. A common practice is to build a root house or cabbage storehouse in a bank of sand or gravel where the drainage is good. For the purpose, the heads should be covered with most of the outside leaves. Keep the room from freezing severely during storage. A slight freeze will not injure the heads. At market time the leaves are trimmed from the heads and they present a fresh, attractive appearance.

Fig. 207 Fig. 208

Fig. 207.—Head of cauliflower poorly developed because of hot, dry weather. (*Productive Vegetable Growing.*)

Fig. 208.—Typical head of cauliflower, well developed, with medium trim, for show in market. (*Productive Vegetable Growing.*)

Job 11. Marketing and Using

Sauerkraut.—A late cabbage crop is often used for making sauerkraut. If a kraut factory is located in the vicinity, much of the late cabbage crop may be sold without storage.

The methods of making kraut at home may be easily learned, as the heads are merely sliced fine and salted to taste. The product is stored in barrels with loose heads, weighted down heavily. The barrels of kraut should be kept in cool cellars.

Marketing Early Crops.—Shipments to market must be made as harvesting proceeds (Figs. 207, 208 and 209). There is seldom any advantage in holding early cabbage and early cauliflower for better prices.

FIG. 209.—A small head of cauliflower of fine quality. (Cornell Reading Circle Leaflet.)

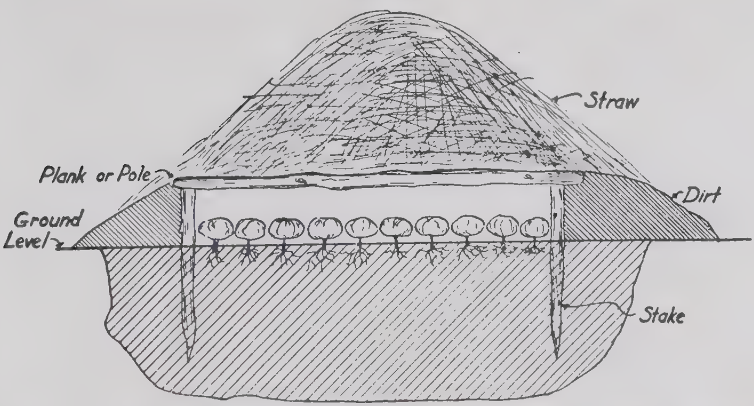


FIG. 209a.—A very good type of mound for home storage of cabbage. (Kansas Agricultural Experiment Station Circular 181.)

Locate open markets by telegraph or telephone to avoid dangers of congestion. Prices are often high in one place and low in another. The pro-

ducer should locate reliable agents through either the railroad company or the express company. Market conditions should be known before shipments are made.

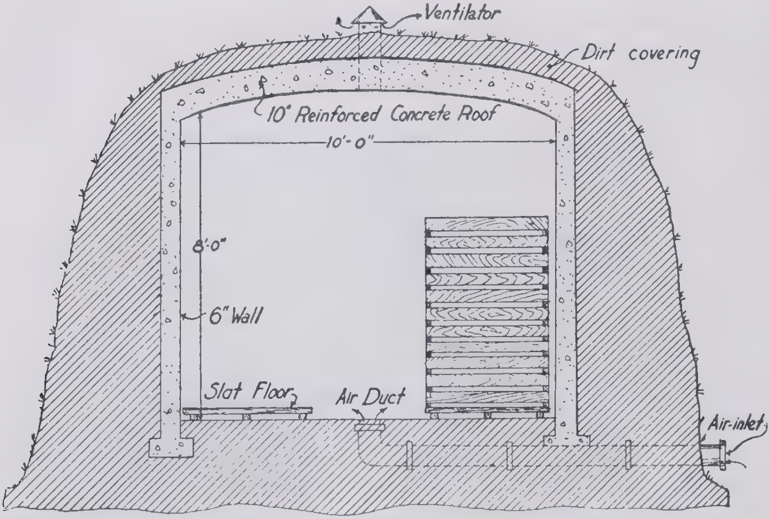


FIG. 209b.—A diagram of an easily built underground storage house for cabbage which may be built near the house and then covered with several feet of soil to serve as insulating material. (Kansas Agricultural Experiment Station Circular 181.)

CHAPTER XVIII

COOKED AND SALAD GREENS ENTERPRISES

Analysis into Jobs.—The following jobs include the main teaching units with mustard, spinach, and other crops of greens. Forms for analysis into problems may be found in other truck-crop enterprises. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with greens, 937, 1044.
2. Choosing the crop and the variety, 1390.
3. Selecting soil and providing plant food, 1390.
4. Preparing soil and planting, 1390.
5. Cultivating the crop, 1390.
6. Controlling enemies, 1371.
7. Harvesting and marketing, 1144, 1189, 1551.

Job 1. Determining Possibilities with Greens

Demand.—Mustard, spinach, and other similar crops of greens are in extensive use throughout America. Not only is there a strong demand in early spring for these crops, but restaurants and homes demand them in nearly all the months of the year.

Ease of Growth.—Where soil conditions are favorable, the crops for greens are among the most profitable when the costs of labor and yields are compared with other crops.

Regions.—These crops are very hardy and should be grown in the cool seasons of the year. In central and southern latitudes, at least as far north as Norfolk, Virginia, and the Ohio River, the crops are often sown in the fall to be harvested in winter or early spring.

Farther north these crops are grown in very early spring and harvested in time to avoid the heat of the summer, as they lose quality very quickly when temperatures are high.

Job 2. Choosing the Crop and the Variety

From the commercial point of view, spinach is far more popular than mustard, except on the southern markets. The grower should consider the market carefully in deciding which type of greens to grow.

Spinach.—Popular market varieties of spinach for eastern markets are Savoy or Bloomsdale and Long Season. Choose a variety which

does not run to seed too soon if warm weather begins. New Zealand spinach is not a member of the spinach family and is discussed later.

Mustard.—Market varieties grown for greens are Southern Giant Curled and Chinese Broad-Leaved. Seven-top turnip is often sown in place of mustard and grown for greens, but may be sold as mustard or "turnip greens." Hanover is often grown and sold in much the same way and passes under the name of Hanover or as mustard or turnip greens. Seed for this is found under the name of Dwarf Essex Rape.

Buying Seed.—Growers seldom produce their own seed. This, however, is possible and good seed may be saved if desired. Seedsmen supply good stock and growers seldom find cause for complaint against such lots of seed.

Job 3. Selecting Soil and Providing Plant Food

Soils.—Any good garden soil is favorable for the growth of these crops of greens. Spinach is most productive on rather rich soils.

All types of greens respond well to the addition of plenty of organic matter. This may be applied in the form of green manure, such as clover, turned under in time to settle well before seed is sown. Barnyard manure may usually be applied freely and abundantly with profit.

Job 4. Preparing Soil and Planting

A Good Seed Bed.—Greens need a good seed bed for proper germination of seed and growth of young seedlings. The seed bed should be harrowed until it is smooth and the top may be planked before planting. The seeds are similar to beet seeds. Germination is rather slow and difficult. Soaking the seed will hasten germination.

Planting.—Rows for spinach should be marked off with a garden marker which places the rows close together. Fourteen to twenty inches is space enough between the rows. Planting may be done with a garden planting machine. Thin drill rows are best. Hand methods may be used and more accurate planting may be done by this method.

Mustard is usually sown broadcast. Other green crops are often sown broadcast. This is particularly true of seven-top turnip and Hanover.

Job 5. Cultivating the Crop

Clean cultivation is necessary. Begin tillage early to stimulate growth from the very first. Keep down all weeds. Give the crop every advantage possible. Frequent tillage pays. Hand-weed hoes may be used if the rows are close together. Crops sown broadcast need no cultivation.

Job 6. Controlling Enemies

The chief enemies of greens are plant lice. These have been discussed in the root-crop enterprise, which see.

Job 7. Harvesting and Marketing

Cutting Greens.—These crops are harvested for market as soon as the leaves are large enough to handle well. The small clumps or heads of spinach are cut near the surface of the ground and placed in crates or similar containers for shipment to market. Slotted barrels are often used. The greens should be pressed firmly in the crate or barrel but there should be plenty of ventilation to prevent heating. If the sun is hot at market time, the greens should be spread out to cool in the shade before packing. Avoid packing greens when they are wet, as heating is more likely to begin.

Selling.—Greens must be fresh when sold. Wilted leaves must never be offered in the market. To prevent wilting, growers selling greens in local markets often wash them or otherwise wet them before they are placed on sale.

When greens are shipped to large markets, dealers usually freshen them in water before they are put in show windows or on sale counters. This is not always necessary and is less commonly practised in cool weather.

Measuring or Weighing.—Formerly greens were usually sold by measuring in peck or half-peck measures. In recent years the practice of weighing has become more common. Consequently, these products are commonly sold by the pound.

New Zealand Spinach

This crop endures hot weather. Instead of sending up flower stems it will continue to grow in hot weather; watering, however, adds much to its qualities. If the new growth is harvested by cutting or breaking above the ground the same plants may continue to yield during the entire season. The seed should be sown in rows far enough apart to allow some form of cultivation. The plants should be thinned to several inches or one foot apart if they are to be used for continuous cropping and growth through the season.

Swiss Chard

This plant belongs to the beet family and has a leaf somewhat resembling the sugar-beet, but with long fleshy leaf stems. These stems may be

cooked and served with cream dressing in a manner similar to serving asparagus (Fig. 210). The leaves themselves are used as greens, and are as mild as spinach for this purpose. There is no fleshy root as in the true beet.

The seeds are sown in rows about fifteen or twenty inches apart to allow tillage between the rows, with the plants six to twelve inches apart in the rows. This planting should be done as early in the spring as the ground

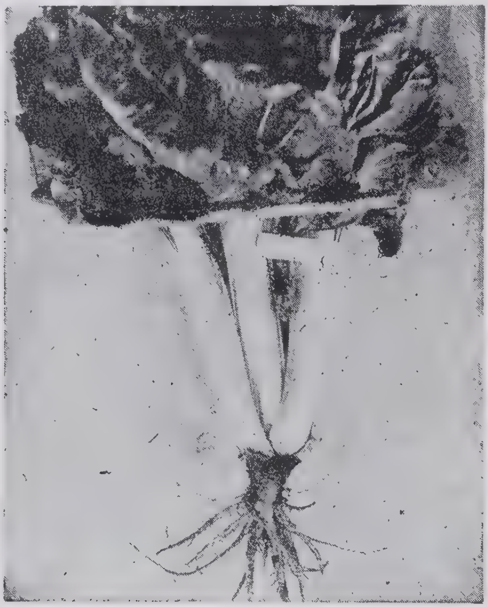


Fig. 210.—Swiss chard, with long white leaf-stems to be stewed and served with cream. (Cornell Reading Circle Leaflet.)

can be prepared. The crop endures hot weather well and will also endure both late spring and early fall frosts. As the leaves become large enough they may be pulled off, the outer ones being used and the central ones allowed to continue their growth. In this way the same plants will continue to supply a crop throughout the entire season. If given thorough tillage and enough moisture, and if conditions are favorable, the crop will not become too fibrous for table use. An immense yield may be obtained from a very few plants. If thinning is required the plants pulled out may be used for greens.

This crop is becoming more popular for home use in America because

it is one of the few garden crops which will endure both extreme cold and summer heat. As the plants are easily transplanted the seed may be sown in hotbeds to get an early start. Transplanting would then take place in very early spring.

Parsley

This product is used for garnishing meat and salad dishes and for seasoning soups. It may be grown in the open garden all through the spring, summer, and fall and in a window box during the winter. The seeds may be sown in window boxes or in hotbeds or cold-frames. The plants may be readily transplanted, and as they will stand considerable frost they may be set in the open garden in early spring. Sometimes the plants are taken from the garden in the fall and transplanted to boxes for storage in vegetable pits or for continued growth indoors. For the winter house plants it is better to sow the seeds in a bed in August or September, watering them well and taking them up before the ground freezes. If only a few leaves are picked they will thrive throughout the season. A few plants in the window during the winter will supply a family. Dried leaves from the summer growth may be preserved for flavoring soups during the winter. While it is a biennial it should be grown only one year.

Upland Cress

This crop is not extensively grown, probably because its merits are not well known. Leaves may be gathered from the growing crop and the plants will continue to form new leaves throughout the season. It is one of the crops which will endure summer heat as well as extreme cold in spring and fall. It is used in very much the same way as water cress, for salads and for garnish. The seed may be sown in the open garden in very early spring. The drill rows may be about eighteen to twenty inches apart. In the southern states a fall crop may be started about the middle of August or even later.

Garden Cress

This product has a burning flavor like that of pepper grass. The seeds are drilled in very early spring, in rows just far enough apart to allow the rake or wheel hoe to pass between. The plants may be thinned by pulling out some for use. The crop is produced very quickly, and is used for garnish or flavoring sandwiches and salads. The plants run to seed if the weather becomes warm before the crop is used.

Corn Salad

This crop is drilled in close rows in very early spring. The clusters of leaves are ready to use in forty to fifty days. The uses and treatment are like those for garden cress. A fall planting may be made just in time to harvest before the ground freezes. Or in regions of mild winters the leaves may be mulched with leaves or straw and the salad used during winter or early spring.

Kale

This is also called *borecole* and belongs to the cabbage group, but produces no heads. It is extremely hardy, and will endure both frost and summer heat. In the southern states it will continue its growth throughout the winter.

Good varieties are Curled, Dwarf Siberian, and Tall Scotch. For the spring crop sow as soon as the soil can be worked. Plant the seeds in drill rows or broadcast. A half ounce of seed is enough to plant 100 feet of drill. Cover about one-fourth to one-half inch. If drill rows are planted allow space for tillage between the rows. As soon as the plants are large enough begin thinning and use them for greens. The young leaves are most tender.

For the fall crop the seed may be sown broadcast over a well prepared seed bed and covered with a rake. This may be done in August or September, or even later in the southern states. Kale is not subject to common garden enemies, and the crop will grow with very little care and attention.

If plants of the spring crop are left in the rows eight inches apart they may continue to yield leaves for greens throughout the season. Only a few leaves are picked from each plant at a time and more continue to form in the center.

Endive

This curly-leaved salad will form dense heads like head lettuce. The crop is grown in much the same way as lettuce, but the leaves need to be tied up to blanch, which removes the bitter taste. Two or three weeks are necessary for this process. Care should be taken that no dew or rain is on the leaves at the time of tying, as rot would start. Rot may also start if the leaves are left tied too long. For home use only a few heads are tied at a time. The young plants can be readily transplanted, and if this plan is followed they are set about one foot apart in rows eighteen inches or two feet apart. The main crop may be harvested in the fall, and a few plants may be transplanted into crates containing a little soil. These crates may be stored in cellars or deep pits, as in the case of celery.

CHAPTER XIX

ENTERPRISE WITH GARDEN PEAS

Analysis into Jobs.—The teaching units or farm jobs in an enterprise with English garden peas may be listed as given below. Forms for analyzing the jobs into problems may be found in other truck-crop enterprises. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with garden peas, 937, 1044.
2. Choosing varieties, 170MP.
3. Procuring good seed; testing; treating, 1253F, 1275F, 1390.
4. Choosing soil and field; providing plant food, 1044.
5. Preparing soil; planting, 1044.
6. Cultivating the crop, 1044.
7. Supporting the vines, 1044.
8. Controlling enemies, 1735F.
9. Harvesting.
10. Marketing; using, 1144, 1253, 1255.

FIG. 211.—Boys of the Cleveland training garden, and the tools they learn to use. (Photo from U. S. D. A.)

Job 1. Determining Possibilities with Garden Peas

Regions.—This crop is abundantly grown in northern and central latitudes, as the plants require a cool condition for growth. It is grown

in winter or in late fall in southern latitudes such as Florida and southern Texas. In those southern climates the crop can stand winter conditions. The earliest varieties will mature in a short period of growth, and the crop is well suited to early growth in northern climates for market and for home use. It is also well suited to small backyard gardens and school gardens. (Fig. 211.)

Production Requirements.—If the labor and capital requirements for this crop are compared with the product secured, it is safe to say that garden peas compare favorably with other garden crops. The growth is not attended with great difficulty. The product is usually in great demand and brings a fair price on the market. There is seldom danger of overproduction of peas. Sometimes unfavorable weather conditions prevail. Hot weather may come on too rapidly for the complete development of the later varieties. This is particularly likely to be the case in central or southern latitudes.

Job 2. Choosing Varieties

Two General Types.—From the character of the seed, this crop may be divided into two types, smooth-seeded and wrinkled. The smooth-seeded peas are the hardier. They may be started earlier in the spring, because they endure cool conditions better than the others. Wrinkled peas are sweeter and are of much better quality. They endure warm weather a little better and can be planted a little later and grown a little later in the season as warm weather approaches.

Size of Plants.—The varieties of peas may be divided into two groups according to the size of the plants. The so-called dwarf peas are about two feet high or less. The tall, or pole peas, are four feet high or more. A medium or half-dwarf group is midway in height between these two extremes.

The size of plants may be used as a guide to the earliness of variety. As a general rule, the early varieties are dwarf in size, the half-dwarfs are a little later, and the tall ones are the latest.

Early Varieties.—Extra Early Alaska and Lightning Excelsior are early dwarf varieties of the smooth-pea type.

Early wrinkled peas which are not very tall but may need some staking are Laxton, Little Marvel, and Laxtonian.

Sugar Peas.—This group is very different from other varieties in that the pods are edible as well as the peas. They are eaten in a more immature condition before the pods become tough. A good variety is called French peas. These are not often sold in market but are frequently grown in home gardens for table use. This variety grows three or four feet in height and should have a brush support.

Later Varieties.—Champion of England is a rather late variety of the wrinkled type. White Marrow Fat is a medium-seasoned smooth variety. Telephone and Dwarf Telephone are wrinkled varieties of the pole type.

Job 3. Procuring Good Seed; Testing; Treating

Fresh Seed.—Gardeners should be certain that the seed to be planted is fresh. Old lots of seed have low germinating power and should seldom be used. Make sure that the seed has not been infested with weevil. Old lots of seed and sometimes rather fresh seed may be badly infested with weevil which greatly reduce the value of the seed. Examine seeds closely to see if there are holes in them. If so, reject the lot as unfit for planting.

Saving Seed.—Gardeners can well afford to save their own seed from home gardens. Careful selection makes it possible to improve the quality and earliness of the crop. If large quantities are to be sown, the patch should be rogued carefully to remove plants which are not typical, produce growth too late, are unproductive, or have pods not typical of the variety.

Buying Seed.—The cost of seed is the chief argument in favor of saving seed at home. The quantity required per acre is about two bushels, and the cost is sufficient to warrant the grower in saving his own seed. However, good lots of seed can usually be purchased if care to inspect them is exercised.

Testing.—A fair sample of 100 seeds should be counted out and tested by rolling them in wet cloths. Such a test will reveal not only the normal germinating power and vitality of the seeds, but should also show which have been infested with weevils

Inoculating Seed.—In regions where peas have been commercially grown, inoculation is usually not necessary. If new soils are to be used, it may pay to inoculate seed before planting. The cost of inoculation is very slight if the agglutination method is used.

Procure a peck of soil from a field where peas have been grown that were well supplied with bacteria on their roots. Put half of this soil in a tub of water and stir it thoroughly until the water is very muddy and until the bacteria of the soil have been washed well into the water. Then pour off the water into a second vessel. Add a small quantity of liquid glue to make the water slightly sticky. Sprinkle this water over the seeds on a smooth floor or other suitable place. Stir the seeds well until all are wet with this water. Then, with a sieve, shake the other half of the soil over the seeds until all are slightly blackened with it. After the seeds have dried for a few hours in a shady place, they are ready to plant.

Such inoculation costs practically nothing, but is an assurance that the crop will be inoculated with suitable bacteria and may make it more successful.

Job 4. Choosing Soil and Field; Providing Plant Food

Suitable Soils.—For early market peas the best soils are sandy loams. When large yields are desired for sale to canneries or for other purposes where earliness is not important, a medium clay-loam soil which is well drained is better. The presence of a good proportion of organic matter will aid in maintaining soil moisture and will prevent the soil from becoming too hot for the crop in the early part of the season. Cool moist soils produce best yields, though later.

Providing Plant Food.—The grower should plan to turn under green-manure crops or plenty of barnyard manure for the sake of providing organic matter in the soil. This will supply fertilizer in a well balanced form. If such organic matter is plowed under in the fall, it should be well settled and sufficiently rotted for a crop the next spring.

When commercial fertilizers are supplied for this crop, they should contain a large proportion of phosphoric acid in an available form, such as is supplied by superphosphate (acid phosphate). The crop makes a quick growth, and such fertilizer should be applied at planting time or just before. If soils are not well supplied with organic matter, and if inoculation is lacking, growth may be hastened by a top dressing of nitrate of soda about the time the seed is germinating or soon after.

Lime is usually beneficial to this crop; and if soils are acid in character an application of lime at planting time is recommended.

Job 5. Preparing Soil; Planting

Fall Plowing.—For the early crop of peas, fall plowing is important. This allows the very early planting of peas which is essential to an early market crop. The soil should be thoroughly disked and harrowed in early spring so that a good seed bed is prepared. This is most important if the crop is to be drilled and not cultivated. Where cultivation is to be practised the seed bed may be planked before marking off the rows.

Planting.—Two methods of planting are in common use. One is the use of grain drills or similar broadcast methods. This plan is well suited to regions where crops of peas are grown for canneries and where machine methods of harvesting are to be used.

The more common garden method is to drill the seeds in rows two or two and one-half feet apart, so that they may be cultivated. Rows of tall varieties may be three feet apart. The seeds are drilled rather thickly

in trenches about four or five inches deep. The best gardeners have learned that the deeper the seed is planted, the better the crop will stand drought and the more productive the vines will be. Seed may be drilled with hand or horse machines very satisfactorily. Such drills usually cover the soil over the seed after drilling.

Time of Planting.—Earliness is very important for market peas. Earliness also serves the purpose of getting a crop produced ahead of warm weather. In northern latitudes March is often a good month for sowing or drilling seed. In general, it may be safe to follow the rule of

Fig. 212.—Planting peas. The rake is used to cover the seeds and firm the soil. It naturally leaves a mulch of loose soil on top. (Minnesota Station.)

planting when oats are planted in early spring. Earlier than this will usually not do any harm. Peas are extremely hardy and can stand much spring frost. Peas will sprout at a low temperature, and it is not necessary for the gardener to wait until the soil is warm.

For kitchen gardens which contain only a few short rows of early peas the garden rake is the most useful implement to use after the first plowing or spading is done. One may do all the planting and subsequent cultivation with a good rake (Fig. 212).

Job 6. Cultivating the Crop

Harrowing.—As soon as the crop is planted, harrowing should begin. One good harrowing at least should take place before the seeds germinate. If the soil becomes packed or crusted another harrowing will aid in keeping the soil in good condition and preventing the starting of weeds ahead of the crop. For the crop which is grown for canneries or produced by the broadcast method, no other cultivation after these early harrowings is possible. The pea vines will grow rapidly enough to keep ahead of the weeds if harrowing has been done just before sprouting.

Cultivation between Rows.—Peas grown for market are usually grown in rows far enough apart to allow intertillage. Hand wheel hoes

FIG. 213.—One attachment of the wheel cultivator is a small turning plow which may be used to cover grass and weeds. This boy makes good use of it. (Bateman Mfg. Co.)

may be used in small gardens (Fig. 213) but horse implements are preferred in large fields. Several cultivations are given the growing crop.

Cultivation should start early and continue until the vines are large enough to be in the way of cultivation.

Job 7. Supporting the Vines

Common Practices.—When peas are sown broadcast for canneries or for other market purposes, they are not staked or supported unless a companion crop, such as rye, is grown with them. The low varieties or those of medium height are seldom staked on commercial plantations,

even when grown in rows. In home gardens, and in some commercial market gardens, the peas are supported in some suitable way to keep the pods from touching the ground.

Means of Support.—Brush is the oldest and most common material used for supporting pea vines. The stems of the brush are stuck into the soil along the rows or between two rows grown close together. In small gardens strings are sometimes used, the upper end being supported on a wire stretched between posts. Wire netting fastened to posts or to stakes is sometimes used, the vines clinging readily to the wire.

Job 8. Controlling Enemies

Mildew.—This disease is common during damp weather. It appears as a gray, moldy growth on the leaves, stems, and pods of the plant.

Leaf Spot.—Leaf spot is a disease which produces dark spots, or blotches, on the leaves. It sometimes attacks the pods and is then popularly known as pod spot. In severe cases it will go through the pods, attacking and spoiling the edible seeds.

Stem Blight.—Stem blight and root rot may be different diseases. The injury is to the stems and roots, which turn brown and then rot.

Wilt.—Wilt is a fungous disease which enters through the roots and causes the plants to turn yellow, wilt, and die, just before the first seeds are mature. Use the newly developed wilt resistant varieties where this disease is prevalent.

Controls.—Seeds should be treated with mercury as recommended for tomato seed, and by the same method (see also Chapter I). Attacks of these diseases may be found if the seeds have been treated, when soil and weather conditions are very unfavorable for growth. Spraying with Bordeaux mixture is not satisfactory or economical. The crop should be grown on new soil or in fields which have not been infested with diseases in former years. Avoid saving seeds from fields which are attacked by disease.

Pea Aphids.—Aphids, or lice, are the worst of the insects attacking peas. Vines are often attacked early by large numbers of plant lice, which are found in great numbers near the top of the vines while young. These suck the sap and distort and dwarf the growth.

As soon as attacks are seen, dusting with nicotine sulfate will control them effectually. This is tobacco dust and is inexpensive. Dust the plants early in the morning when there is plenty of dew so that the nicotine will dissolve and attack the lice.

Pea Weevils.—These minute beetles are much more injurious to the pea crop in central and southern latitudes than in the northern latitudes. The small beetles lay eggs on the surfaces of pods in the

field. The larvæ infest the seeds and are often carried into storage places with the crop. Much damage is thus done where infestation is severe. The weevils may pass the winter in the store rooms, in the seeds, in fields, or in buildings wherever there is a protective place.

The best control is to examine the seeds thoroughly before planting and avoid introducing the enemy into the field at planting time. Treating seed with mercury, as recommended against diseases, will also prevent this insect from living in the seed at planting time. Fields should be thoroughly cleaned up and all refuse plowed under in the fall. Seed being held over for planting should be fumigated in closed vessels with carbon bisulfide to destroy the adult weevils and any larvæ which may be in the seed. For large quantities of seed the carbon bisulfide is used at the rate of one pint in 500 cubic feet of space. The liquid is placed at the top of the lot of seed in an open vessel; and, if all spaces are thoroughly closed, the fumes will kill the weevils in the seed. The fumes are poisonous to all animal life, and care in using this treatment must be exercised. There must be no fire or light, as the gas formed is highly explosive.

Job 9. Harvesting

Hand Picking.—Picking by hand is a very expensive way of harvesting, but this method is usually practised. Dr. Norton of the U. S. Department of Agriculture estimated that the costs of this operation equal all of the other costs of this enterprise. Two or three pickings are made, as a usual thing. When only one picking is made, the vines may be pulled, and pods of the proper maturity are picked off more rapidly than if they were standing in the field. This method gives lower yield and causes much waste. The product is not nearly so well graded as when three pickings or so are made.

Machine Harvesting.—When peas have been sown or drilled broadcast, the crop is usually harvested with hay-making machinery. Mowing machines are used to cut the vines down. They are then raked and hauled in with wagons. As many of the vines are likely to be lying on the ground, low mowing is very necessary, and sometimes lifters are devised for raising the vines before cutting. Windrow devices are sometimes attached behind the mower blade to move the vines toward the center of the swath. Forks may then be used in lifting the vines in loading. This obviates the need of using hand rakes. Hay loaders are sometimes used.

Judging Maturity for Canning.—The grower must judge the appearance of the pods. Close examination will reveal the condition of the growth. The pods should be well filled and the peas somewhat

mature but still green and never tingeing to yellow. When the bulk of the crop is in this condition, harvesting should take place. Canneries take a product which is only slightly more mature than that supplied to the market. Investigations show that 1500 to 2000 pounds of shelled peas from an acre, grown for canneries, is a fair yield. The heavier yields are to be had from the wrinkled varieties. The thrashing is done at the cannery or depots which they establish.

Job 10. Marketing; Using

Packing.—Peas are packed in hampers or other baskets for shipment to market. Round bushel baskets are popular in some sections. Peas are shipped in pods and are never shelled before shipment. Each package should be thoroughly looked over to remove foreign matter such as stems, leaves, broken pods, and any pods which do not present a good appearance.

Shipment.—The very earliest peas are often shipped to market by express. For longer distances refrigerator cars are commonly used. If the peas are kept cold during shipment, they will reach market in a much fresher condition than otherwise. The pods should never present a dried or shriveled appearance on the market. Coöperative loading and shipping is frequently practised in regions where the crop is grown intensively.

Canning.—Many peas are grown in fields especially for canning factories. In other cases, canneries are established and run temporarily each year to take care of the surplus product left over from marketing. The entire vines are mowed and hauled into the canneries when most of the pods are in the best condition for use. Specially prepared threshing machines handle the vines, shelling the peas from the pods as the crop is passed through the thresher. The peas are delivered in a rather clean condition, ready for the canning process. They may be graded by passing over screens used for that purpose. Two or three grades of peas are usually produced, varying in size and maturity. The peas are then washed before cooking for canning.

By-Products.—The vines and pods are by-products from canneries. These are sometimes put into silos or may be taken by the growers to their farms for use as feed for livestock or for manure. Similar by-products are produced when peas are harvested for feed to be sold through feed houses. In this case, the vines are rather mature and are sometimes called pea straw. This may be saved for livestock and fed in a dry condition during the winter.

Feed Crop.—Stock peas are often sown broadcast as described for the growing of peas for canneries. Different varieties are used for this purpose. They are often mixed with oats for this purpose, one bushel of peas and

one bushel of oats being used as seed for this crop. These may be mowed and harvested together when the oats are in the milk stage or a little earlier. This produces a splendid hay mixture for dairy cattle and other livestock. If the crop is allowed to mature before cutting, the seeds of both peas and oats can be threshed out together. These may be ground together and used for feeding farm animals. For farm feeding peas are seldom grown alone, as they are more easily mowed when a companion crop such as oats is grown with them.

Peas grown for feed purposes are of no value for table purposes. When the tops are completely removed, either fresh for hay or harvested for canneries, the crop is of little or no value as a leguminous soil improvement crop. However, if it is not harvested, it is of value as a fertilizer for late crops.

CHAPTER XX

WOODLAND ENTERPRISE

Analysis into Jobs.—A woodland enterprise is naturally divided into the following farm jobs or teaching units. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with a woodland enterprise, 29L, 863D, 1071F, 1117F, 1177F, 1312F, 1405F, 1603F, 1608F.
2. Choosing the types and species of trees, 31MC, 173F, 358F, 544D, 1061D, 1291D, 1392F, 1671F, 1693F.
3. Selecting the area, 217MP.
4. Starting seedlings; managing nurseries, 1123F, 1603F.
5. Buying trees, 700.
6. Preparing the soil for planting, 1209.
7. Planting, 1209, 1312, 1492, 1501.
8. Controlling insects and diseases, 705, 995, 1154F, 1169, 1364, 1623F.
9. Controlling fires and other injurious factors, 1294D, 1495D.
10. Reforestation, 1177, 1178, 1492.
11. Harvesting woodland products, 30L, 105C, 131C, 744F, 1660F, 1756F.
12. Marketing and using products, 207C, 295C, 1210, 1459.

Job 1. Determining Possibilities with a Woodland Enterprise

Conditions Usually Found.—(1) Far too many farmers fail to grow or maintain a farm woods. (2) Those who have such an area on the farm usually find it profitable in a number of ways. (3) There is a prevalent feeling among many people that a woodland enterprise should be found on most farms, if not on all.

Aims.—(1) Young farmers should seriously consider the possibilities with a woodland. (2) They should know its advantages and the capital and labor requirements.

Problems for Study and Discussion

1. How many farmers in your region maintain areas for the production of wood posts, or lumber?
2. What objections are found among those who do not have woodlands?
3. How much of the land area in your region is suited better for growing woods than for farm crops?
4. How much of the area is stony or hilly?
5. How much is too low and wet for the growing of agricultural products?
6. What products may be secured from woodland on your farm?
7. What is the least number of years required for the growth of any of these products?
8. How many years would be required for the production of lumber?
9. What tax exemption, if any, is allowed in your state for farm woodlands?
10. Try to justify tax exemption laws in states which have them.
11. What would be the cost per acre of trees and labor for planting?

Projects.—(1) Students may take over home woodlots for a year or more, caring for the areas in every way, and harvesting and selling the products. (2) A few students may conduct projects in growing and selling forest nursery stock.

Products of the Woodland.—Woodlands in general yield many products valuable on the farm, in manufacturing, and in commerce. The following products have been enumerated: Nuts and fruits, sugar and syrup, (Fig. 214), quinine, salicin, oils of sassafras, eucalyptus, beechnut, and olive, matches, tooth picks, clothes pins, pencils, penholders, handles, baskets, shoe pegs, wooden dishes, wood alcohol, acetates, wood tar,

Fig. 214.—Buckets catching sap from spouts in sugar-maple trees.

potash, turpentine, resin, creosote, pitch, cork, tannic acid, charcoal, spruce gum, lamp black, excelsior, lumber, posts, poles, ties, fuel, and pulp.

Windbreaks and Shelter Belts.—The Middle West, including the prairie states, would be greatly improved by having a number of windbreaks and wide shelter belts on every farm. A shelter belt differs from a wind break in the width of the area planted. There are objections to growing trees near productive fields because of plant food which the trees take from the soil near the crops. A shelter belt will do no more damage to the adjoining field than the narrow windbreak, and will on the other hand produce far more timber products in proportion to the amount of land used.

The timber grown on a wide shelter belt is of better quality than that grown in a narrow windbreak. Trees in wide plantations grow straight, and have fewer knots than those with open ground on both sides. The denser the trees are grown the taller and straighter will be the timber, and the freedom from knots and side limbs is remarkable.

Shelter belts should be planted with trees suited to the region. In the Middle West walnuts, hickories, elms, and other hardwoods are usually thrifty and successful (Fig. 215). The cone-bearing trees, such as pines hemlocks, and spruces, will not endure the dry seasons of much of the western prairie region. Those trees should be selected which the experience of others has proved suitable to your section.

FIG. 215.—A mixture of hardwood and evergreens is most successful in the farm woodlot. (Indian Rock Farm.)

The width of the shelter belt may be made to suit the desires and conditions of the owner. The trees should be set about seven to ten feet between the rows, and about ten feet apart in the rows. The species should be mixed rather than planted in solid blocks of each kind.

Tax Exemption.—Several states have laws designed to relieve the tax burden on areas which the owner devotes to the growing of timber. Such laws are enacted also to encourage forest renewal and replacement. This is on the theory that forests are a public benefit. If land were taxed for the number of years required for the production of these products, the income at harvest time would be largely overbalanced by the amount paid in taxes.

The Farmer's Needs.—From the farmer's own point of view it is

worth while to have a woodland. His home fuel supply is needed, also wood for poles, posts, rails, and other articles. This surely is enough to warrant his keeping a good woodland perpetually on his place.

Number of Years to Wait.—A period of only a few years is required for the production of wood, poles, and posts, but growth for railroad ties and lumber needs more time. Some quick-growing species will produce lumber of value in fifteen to twenty-five years. Valuable windbreaks may be produced in four or five years.

Costs.—Tree seedlings may be produced or purchased at very low prices per thousand. The actual cost depends upon the varieties or spe-

FIG. 216.—Spruce, cedar, and pine will grow well on rocky hillsides and yield valuable products. (Photo by Waugh.)

cies. The growth of trees from seed is easily accomplished with many species. The outlay for trees in this case would be only the cost of seed.

The labor requirements for planting trees in rows may be compared with the cost of setting tomato plants in a field. As this labor item occurs only once in many years, the expense is almost negligible.

Job 2. Choosing the Types and Species of Trees

Conditions Usually Found.—Some growers plant poor kinds of trees because they grow quickly. (2) Others with more knowledge of tree growth select species more wisely.

Aims.—(1) Students should know the rapidity of growth of different trees for the region. (2) They should know the character of the wood of each and the uses to which the wood can be placed.

Problems for Study and Discussion

1. What woods are considered best for posts and poles?
2. What trees show most rapid growth in your region?

Fig. 217.—White pines make rapid growth of wood valuable for lumber. They must be grown in dense plantations for best results. (Photo by Waugh.)

3. What woods are commonly used for railroad ties?
4. What forms of lumber that would grow in your region bring highest prices in the market?
5. What trees are best suited to low, wet soils?
6. Make a list of trees which you think you would want to grow for a windbreak.
7. What trees could be easily grown from seed?
8. Name species which would stand drouth well.

Fig. 218

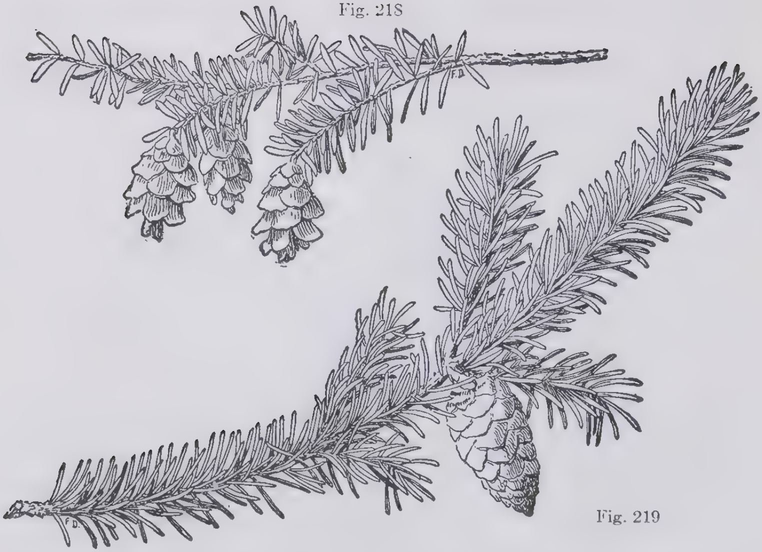


Fig. 219

Fig. 218.—The hemlock becomes a large, graceful tree, native east of the Mississippi River. The bark is harvested for tanning and wood is used for paper or sawed for framing lumber.

Fig. 219.—White spruce is one of the most graceful evergreens for ornamental planting. The tree is native in the northern states and Canada to Alaska. The woods of this and black spruce are used for general construction, span, flooring, sounding boards of musical instruments, paper pulp, etc.

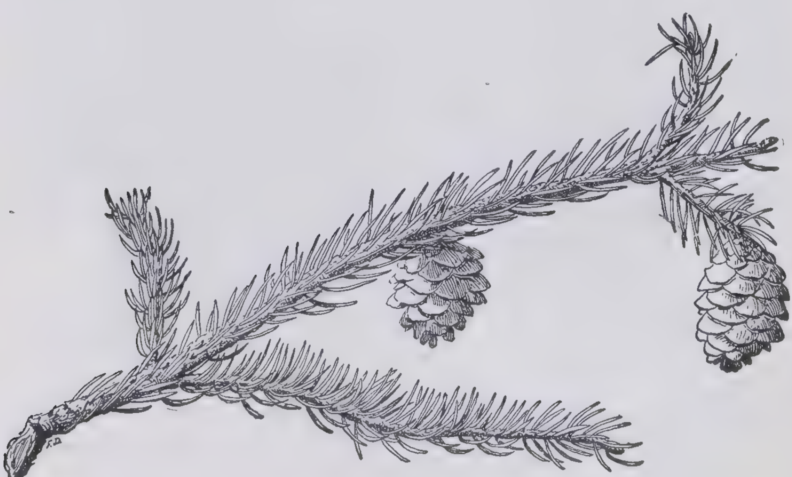


Fig. 220.—Black spruce is not an ornamental tree, as the dead cones hang on and the lower branches die. The native ranges and uses are much the same as white spruce.

Activities.—(1) Collect specimens of leaves, twigs, flowers, and seeds of as many kinds of trees as possible. (2) Mount these on cards or on pages of a blank book. (3) Collect specimens of wood of trees used for lumber, posts, poles, ties, etc.

Kinds of Trees.—In regions where native woods prevail it is well to select species already present which are known to suit the region and soil. For producing timber those species should be chosen which will bring good market prices for the particular products desired, as lumber, poles, ties, and posts. Chestnut trees are not profitable because of the losses from chestnut blight disease. The black walnut yields valuable products and grows in regions somewhat drier than trees having shallow roots. The cottonwood and other poplars are sometimes the only trees found along streams in prairie regions and cold climates. Their wood is chiefly used for fuel. Their cuttings will root easily. Pecans should appear in the lists for southern regions. Sugar maples should be grown in cold climates for lumber and syrup. (Fig. 214.) The hardy catalpa tree is well suited to the central sections, but requires rich, moist soil.

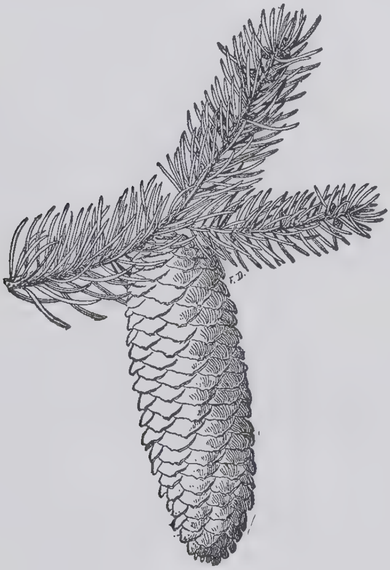


Fig. 221.—Norway spruce is used more than any other spruce for ornamental planting, for which purpose it is grown in nurseries from seed. The tree is readily identified by its six-inch cones and its pendulous branches.

The wood is extremely valuable for posts and poles, and is very durable. The red cedar makes good posts and lumber (Fig. 216), but because of rust disease which comes from it, the cedar should not be grown where apple orchards are desired. In the pine belt the native species should be chosen (Fig. 217). The black locust makes good posts and is a rapid grower. The oaks are slow growers but produce valuable lumber and ties.

Rapid Growth.—A tree planter naturally prefers trees which make rapid growth. Among the species which fulfill this requirement and are also durable in character are hardy catalpa, black walnut, tulip poplar, red oak, black locust, and pines. Other rapid growers which are less

FIG. 222.—Larch or tamarack has very shallow roots and may be grown in rocky and swampy places. This is the western species.

desirable for market or for use as lumber or posts, but which may be used for windbreaks or for fuel, are cottonwoods and other poplars, soft maples, and honey locusts.

Among the slow growers which are otherwise very desirable may be mentioned the oaks, beech, hard maples, red cedar, hickories, ash, hemlock (Fig. 218), and spruce (Figs. 219, 220, 221).

Lumber Species.—When woodlands are to be maintained partly for the production of lumber, they should include the best species of pines, black walnut, oak, and tulip poplar.

Trees for Wet Places.—Swampy areas are well suited to the growth of beech, some species of birch, poplars, willows, some species of elm,

FIG. 223.—Grazing land provided with a natural windbreak. (U. S. Forest Service.)

FIG. 224.—The rugged banks of streams may well be used for the growth of posts, ties, and fuel. (Photos by Waugh.)

sycamore, larch or tamarack (Fig. 222), and water maple. The most durable and salable woods in this group are beech, birch, and willows. The latter are often used for furniture and basketry. (U. S. Farmers' Bulletin 622.)

Drouth Resistance.—Some trees are much better than others for growth on prairie lands of the semi-arid regions. When trees are wanted for windbreaks or for fuel in these regions, species which will endure the climate must be selected. Cottonwoods and other poplars, Russian mulberry, and some species of pine may be successful.

Species to Grow from Seed.—Popular kinds of trees which can be readily started from seed include catalpa, maples, walnut, oaks, hickories, elms, mulberries, pines, ash, linden, locust, and tulip poplar.

Job 3. Selecting the Area

Conditions Usually Found.—(1) The most profitable woodlands are on areas not needed for or least suited to producing agricultural crops. (2) Stony, hilly, stumpy, and swampy lands are often used as farm woodlands.

Aims.—(1) The importance of choosing lands which would not produce farm crops readily or which are otherwise not suitable for tillage should be understood by students. (2) The selection of areas which ought to be used as farm woodlands should be practised.

Problems for Study and Discussion

1. What sites of your region seem to produce most rapid growth of trees?
2. Compare hilly and stony fields with lowlands for growth of trees in your region.
3. How would you locate a windbreak or shelter belt for your farmstead?
4. Select hilly or stony fields which might be used as woodlands.
5. Discuss the use of stumpy land for growing trees.
6. What agricultural crops would these fields grow profitably?
7. What losses would the owner have by leaving such areas idle?

Activities.—A contest may be planned in selecting land better suited for wood growth than for farm crops. Several farms may be examined and the areas stepped off by each student.

Hillsides.—Denuded hillsides or gullied old-fields may well be planted to trees which will prevent washing and eventually reclaim the land. Black locusts are often used for this purpose. Many hillsides and worthless lands have been cleared of native woods and allowed to erode for years. The owner merely robbed nature of her timber supply without leaving trees with which to reforest the place. The use of such areas as permanent woodlands will return a profit instead of a loss for the farm.

Rocky Fields.—On many farms there are rocky fields which cannot be used for agricultural products. Trees may be reëstablished on these and good returns secured with little expense. No cultivation will be necessary for some kinds of trees. Such fields are not tillable and may produce little pasture or farm crops (Fig. 224).

Wet Lands.—Low, wet lands, flooded during wet seasons, may be made to grow trees which endure such conditions (Fig. 225). Many such fields are unsuitable for agricultural products. They may be too wet much of the time for use as pastures or for hay. To leave them idle would mean little or no income, yet taxes on them would continue year by year.

Locating Windbreaks.—Shelter belts and windbreaks are often planted on the windward side of the farmstead. These should be rather wide rows of trees to effectually break the high winds in open regions. Consequently it is sometimes necessary to devote rather valuable land to this purpose. (Figs. 223 and 231.)

Fig. 225.—Where streams are bordered by trees and the fields covered with grass or other protection the water is clear and soil is not being eroded.

The returns from the growth of trees on such land are usually greater than where less favorable soils are used. The owner should plan to grow catalpas, walnuts, or other species which will yield good returns in wood or timber for the use of such valuable land in addition to the protection they give.

Stumpy Land.—Fields having many stumps have proved their ability to grow trees. Stumps need not be cleared off if trees are to be grown. This may be the best use for such lands.

Job 4. Starting Seedlings; Managing Nurseries

Conditions Usually Found.—(1) Few farmers grow their own seedlings. (2) Some farmers find the growing of their planting stock more profitable than buying it.

Aims.—Students should learn methods of obtaining seeds and of establishing and maintaining seed beds.

Problems for Study and Discussion

1. What forest seeds could be collected in your region?
2. At what time of year should seeds of the different species be collected?
3. When should each of these kinds be planted?
4. Describe a good seed bed for forest trees.
5. Why is shade desirable?
6. Give directions for care and management of a bed of forest seedlings.
7. When should seedlings be transplanted?
8. What tree seeds may be started in nursery rows?
9. What care should be given them during the nursery period?

Activities.—Every student should practise the growing of at least a few seedlings and cuttings of several kinds to become familiar with the operations and management involved.

Fig. 226.—Seeds of catalpa and many other trees may be drilled in rows so that the young trees may be cultivated for a year before transplanting to the woodland or shelter belt.

Obtaining Fresh Seeds.—Most tree seeds deteriorate rapidly. They should therefore be collected or purchased fresh each year and planted as soon as conditions will warrant.

Early seeding trees, such as most of the elms and maples, mature their seeds in spring. Such seeds should be collected as soon as they are ripe and planted immediately. Seeds which mature in late summer or fall, such as walnuts, basswood, locusts, acorns, hickory nuts, and pines, should usually be planted the same fall. Some of them may preferably be kept over until spring.

Beds for Seedlings.—Crude frames may be constructed of logs or poles for starting young seedlings. These should be placed in sheltered spots where they may be shaded either by other trees or by latticework constructed for the purpose. Most seeds should be planted very shallow. Squirrels and other enemies may be kept out by suitable covers or by the

use of dense brush until the seeds germinate. Wire screens are often used for this purpose.

Beds should be watered frequently enough to secure a steady or desired growth of the seedlings. If glass or other covers are used over the beds, ventilation must be watched; overheating of the beds must be avoided. Most species of tree seeds need no extra heat for germination and growth.

Transplanting.—Year-old seedlings may be transplanted on areas where they are to stand permanently or in nursery rows to obtain a better growth and root systems before final transplanting. Fall and early spring are good seasons for transplanting.

Planting in Nursery Rows.—Many kinds of tree seeds may be drilled separately in nursery rows where the trees are to remain a year or more (Fig. 226). This treatment is suited to walnuts, hickories, maples, oaks, locusts, and the most thrifty pines.

Clean cultivation should be given between these rows, as if they were garden plants. Species which have tap roots should remain in these rows only one year before transplanting. This is true of most nut-bearing trees and tulip poplars. Oaks may remain two years or more in the nursery rows.

Cuttings.—A number of forest trees are started from cuttings. Among these may be mentioned arbor vitæ, willows, and cottonwoods.

Arbor vitæ may be started from green cuttings of the branchlets. These are usually propagated in beds until they are well rooted and may then be transplanted to nursery rows. Willows and cottonwoods are readily propagated from cuttings during the dormant season. The small branches or twigs are cut from the thrifty growths and planted in trenches or furrows in the nursery row where they root readily the following spring.

Job 5. Buying Trees

Conditions Usually Found.—(1) Forest nurseries located in different regions supply tree seedlings for planting farm woodlands. (2) Prices for young trees are usually reasonable.

Aims.—Students should know how to choose trees from nurseries and how to manage them after shipment.

Problems for Study and Discussion

1. Locate the nearest and best tree nurseries available for your region.
2. Obtain price lists and compare prices of trees at different ages.
3. How are sizes of trees indicated?
4. Try to explain why prices of different kinds of trees vary so widely.
5. When would you order trees for planting your farm woods?
6. How many kinds of trees would you buy? Why?

7. What shipping directions would you give to the nursery?
8. Why should trees be heeled-in upon arrival?
9. How and where would you do this?

Catalogs.—Send to a number of forest nursery companies for catalogs and price lists. Compare prices, sizes, and species.

Sizes and Ages.—Some kinds of forest trees should be planted when very young. This is particularly true of those which have tap roots, as walnut, hickory, tulip poplar, and some species of pine. Trees having fibrous roots may be successfully transplanted when older. It may pay the grower, however, to buy trees when young, regardless of the kind. Prices are usually much less for the small trees. Sizes of trees are often indicated in catalogs by the height or by the diameter a few inches or one foot above the ground.

The chief objection to planting very small trees is that they are not so easily protected during the first years of growth in the wood. If livestock are not allowed to graze thereon and if the trees are placed in rows for cultivation, this objection need not be a serious one.

Variations in Price.—A comparison of several catalogs will show that certain kinds of trees are much cheaper in some regions than in others. This is due to availability of seed or other conditions more favorable for growth in regions where the trees are low in price. Wholesale prices may usually be secured when large numbers of trees are to be planted.

Ordering.—It usually pays to get special quotations on large lots of trees before ordering, and, if possible, orders should be placed some months in advance of shipment. Those placed in early winter may be delivered in early spring. This plan gives nurseries more time to assemble the trees, permits digging to suit available orders, and tends to lessen the substitution of other species.

It usually pays to allow some substitution on the part of the nursery but the grower should designate what substitutions are allowed by making a list of his second choice of species.

The number of kinds of trees to be purchased and planted should be studied carefully by the grower. Mixed plantings are usually most successful, for several reasons. Some species develop better when mixed with other trees than they do in pure stands. There is less loss from drouth, insects, and diseases. Study what species are found growing together in native woods if possible. Tree experts may indicate which species grow well together in your region.

Receiving Shipments.—When notice is received of the shipment of orders, watch the receiving station closely so that the trees may be moved promptly to a safe place. They should not remain long in heated

depots or in the hot sun or wind. The packages should be opened immediately and the trees heeled-in where the roots will be in contact with good moist soil.

A good place for this is near the center of the plot to be planted. Trees can then be carried easily to all parts of the area. Slope the trees toward the north or toward the upper side of the field. Cover the roots thoroughly with soil and tramp to avoid large air spaces about the roots.

Job 6. Preparing the Soil for Planting

Conditions Usually Found.—(1) Rough lands are usually poorly prepared for planting trees. (2) Shelter belts and strips for windbreaks are commonly prepared well.

Aims.—Economical methods of preparing soil for planting trees should be understood for students.

Problems for Study and Discussion

1. Why should soil be well prepared for the planting of forest trees?
2. What methods of preparation are suitable for windbreak strips and shelter belts?
3. How long before planting would you plow the soil?
4. Discuss depth of plowing.
5. If the area has been in sod, how much disking and harrowing will probably be necessary before planting?
6. How can you break up the soil for woodland to be planted on a rocky field?
7. If hand methods must be used, what hand tools would suit best?
8. If old stump land is to be planted to trees, what kind of plow would you use if you could plow the land at all?
9. What use could you make of a disk harrow in preparing stump land for planting?
10. If a steep hillside is to be used for farm woods, describe a good method of preparing the soil.

Activities.—The most economical methods of preparing soil for planting trees should be compared by making trials. Include several kinds of areas if possible, as stony fields, steep hills, stumpy lands, and swampy lands.

Purpose of Preparation.—If young saplings, seedling trees, or tree seeds are to be used in starting a woodland, the soil should be prepared sufficiently to allow the growth of the young trees without serious interference from weeds, grass, and other growth. If trees have serious competition when started the results will be unsatisfactory. The soil should be sufficiently loose to allow easy penetration by the roots. It is not necessary that the soil be firm, but it may be plowed only a short time before planting if necessary.

Shelter Belts.—For the planting of shelter belts, the area should be plowed rather deep. The roots are to be in deeper soil than most farm crops. The good soil may be turned to a depth of eight or ten inches without injurious results. If the subsoil is loose, deep plowing is not advisable. Plow the whole area with a turning plow or disk plow. Then

follow with a disk harrow so that clods and sods will be well broken. The surface may be smoothed with a spike-tooth harrow before planting. The lines for each row of trees may be marked out with a bulltongue plow or lister to a depth to suit the size of trees to be planted. Very shallow furrows are needed for small seedlings.

Rocky Fields.—Such fields present one of the most difficult problems of soil preparation. Sometimes there is present much wild growth which should be subdued before planting trees. The use of sheep or goats for a few months may help. The soil should be disked if possible and perhaps some hand work may be done with mattocks to break up the soil near rocky ledges and places where disk harrows cannot be used. Such rocky lands may be very favorable for the growth of certain kinds of forest trees, and with proper preparation the results may be very satisfactory.

Stump Lands.—This type of land is discussed in the reforesting job. Old stump lands may have been used for pastures and may have established heavy turf. In such a condition, the treatment would be similar to that mentioned in the preceding paragraph. Use a disk harrow after the livestock and use mattocks where necessary.

Hillsides.—If hillsides are neither stumpy nor stony, they can usually be planted with the rows running around the hills. This is probably the best plan to follow in such cases. One extra ridge may be formed every three to six rows of trees, according to the steepness of the slope. Furrows should always run on the level around the hillside. If the hillside is stumpy or stony, a disk harrow and hand tools should be used.

Job 7. Planting

Conditions Usually Found.—(1) Experienced foresters use rapid and economical methods in planting. (2) Beginners are likely to make serious mistakes and get poor results in planting.

Aims.—The best and most economical methods of planting should be understood and practised.

Problems for Study and Discussion

1. Describe the making of holes for large trees.
2. Why should the top soil be kept separate from the subsoil in digging holes?
3. Why should the soil be tramped about the roots of the tree in planting?
4. Under what conditions would you leave the soil at the top lower than the level? When not?
5. In what regards is fall planting less desirable for large trees?
6. At what intervals would you plant large trees in a shelter belt?
7. What are the advantages of mixing two or more kinds of trees?
8. Describe a good method of planting small seedlings in a smooth shelter belt.
9. Describe a good method of planting small seedlings in rocky or stumpy fields.
10. Describe the mattock method of planting seedlings.
11. Under what conditions would you plant seeds directly in the farm woods?

Activities.—Contests in speed and efficiency of planting may be planned. Include the planting of large and small seedlings on several types of fields.

Making Holes for Trees.—If holes are to be dug for large trees, they should be made somewhat larger than the roots require. In rough lands, hand methods of digging are sometimes necessary. In such cases, the top soil should be kept separate from the subsoil, so that when the tree is planted the best soil may be placed next to the roots.

Planting Large Trees.—Roots that are broken should be pruned. Extra long roots should also be cut off. The tops should be pruned to correspond to the root pruning. Place some good soil in the bottom of the hole. Then place the tree at a depth so that it will be a little deeper than before transplanting. Tramp the black soil firmly next to the roots. The poorer soil may be used on top. In dry regions or in dry weather the planting should be done immediately after the digging of the holes. In dry conditions the surface should be left depressed around the tree to hold extra rain water. If fall planting is practised, the surface at each tree should usually be left level to avoid the accumulation of extra water during the wet season.

Planting Season.—Large trees should be planted in very early spring. If fall planting is practised, the trees may be whipped about by the winter winds before root growth begins. Holes thus formed about the trunks of the trees may be detrimental by allowing the admission of too much air in dry weather or too much free water in wet weather.

Small seedlings may be planted in either fall or spring, as conditions may require.

Distances for Planting.—In shelter belts, trees may be planted at uniform distances to suit their sizes and types of growth. The rows may be six to ten feet apart, and the trees about ten feet apart in the rows.

If mixed plantings are made, the number of trees per acre may be increased by closer planting both ways. Sometimes two or three kinds are planted in rotation in each row. In other cases only one kind is planted in each row.

Advantages of Mixtures.—There are a number of advantages derived from mixing the trees instead of planting only one kind:

1. There is less danger of total loss from drought, insects, and diseases.
2. Rapid-growing trees may temporarily fill the area while the slower and more permanent ones are becoming large enough.
3. Tender kinds, such as Scotch pine, do much better when partially protected by more hardy trees.
4. Mixed plantings are more beautiful and interesting.
5. Birds are attracted by the greater variety of food and shelter.

6. The ground is usually better shaded by mixed planting. Tall trees with thin foliage, such as maple and birch, may be alternated with those which have dense foliage and can endure shade well, such as spruce and beech.

Setting Small Seedlings.—When small seedlings are to be planted in rather level fields where the ground has been well plowed and marked out in furrows of suitable depth, the seedlings may be very rapidly planted by hand methods. One person may drop the seedlings at suitable distances along the rows while others complete the planting with hoes or shovels. Sometimes enough soil may be moved in with the foot and tramped at the same time around the roots.

When small trees are to be planted on rocky or stumpy fields, small trenches may be made in some cases by using a bulltongue plow and a

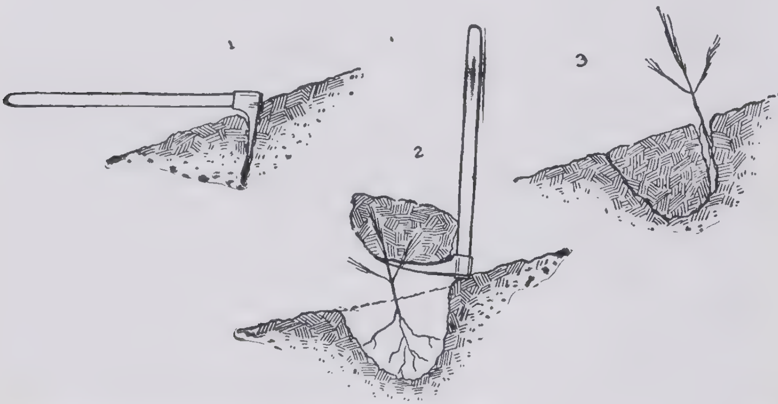


Fig. 227.—The mattock method of rapid planting of forest trees. (Cornell Reading Lesson 159.)

single mule or horse. This method will leave the soil in better condition for planting and will cost less than the mattock method. The trees should then be planted in the bulltongue furrows according to methods already described.

The Mattock Method.—This method is mentioned in the reforesting job. One person uses a mattock to lift the soil while his assistant places the roots of the seedling in the hole and tramps the dirt in place (Fig. 227).

Planting Seeds Direct in the Field.—For such trees as have tap roots, planting seeds direct in the field may be practised economically. This condition may occur with walnuts, butternuts, hickories, pecans, and tulip poplars. Sometimes other trees are sown in fields, particularly

when the soil is very rocky, stumpy, or otherwise unsuited to careful planting of trees. Seeds are much cheaper than trees, but more time is required for their development into forest products.

Job 8. Controlling Insects and Diseases

Conditions Usually Found.—(1) Forest trees are rarely harmed by insects and diseases so seriously as to cause much loss. (2) In some cases disease or insect attacks are so injurious as to require special means of control.

Aims.—Students should know that enemies are likely to attack the trees they are growing and how to prevent or control them.

Problems for Study and Discussion

1. Read bulletins on chestnut blight and tell how this disease works and how it is controlled.
2. In like manner, study the effects and control of the white pine blister rust.
3. What enemy of pecans and hickories is likely to affect these species? How is it controlled?
4. How are web worms in a forest most easily controlled?
5. What are the best means of fighting tent caterpillars?
6. Discuss the value of making birds contented in a woodland.
7. How may this be done?
8. What special enemies are found in local woodlands or shelter belts? How are they controlled?
9. What trees of local woodlands or forests are attacked by borers?
10. Leaf-eating insects may be controlled by what common method?

Activities.—(1) Conduct different methods of controlling farm-woodland tree enemies found locally. (2) Where tall trees are to be sprayed against leaf-eating insects, construct a tall tower from which to reach their tops with a spray rod.

Rots.—Wounded, weakened, and old trees may be seriously attacked by several kinds of rot. Trees which have been injured by forest fires are often attacked by insects and diseases. Pruning, painting, and other care will greatly aid in preventing such attacks (Fig. 228). Roadside trees, street trees, and others used for shade should be given special care.

Chestnut Blight.—This disease has killed most of the chestnut trees in much of the eastern United States. It is so serious as to make the propagation and planting of this species questionable. Methods of control are not well understood. Many growers have harvested their chestnut timber to prevent damage from this disease. It has spread to all parts of the United States, destroying the chestnut trees. It was imported from Asia where there are varieties resistant or perhaps immune to its attacks. These varieties are not adapted to conditions in America.

Pine Blister Rust.—This disease has killed many of the white pine trees of the eastern states. The replanting of the species in such regions is not advisable. In the northwestern states the trouble has not been so serious as to interfere with the forest growth. Other species of pine have not been seriously attacked. (U. S. Farmers' Bulletin 1398.)

The disease must spend one cycle of its life on gooseberry and cur-

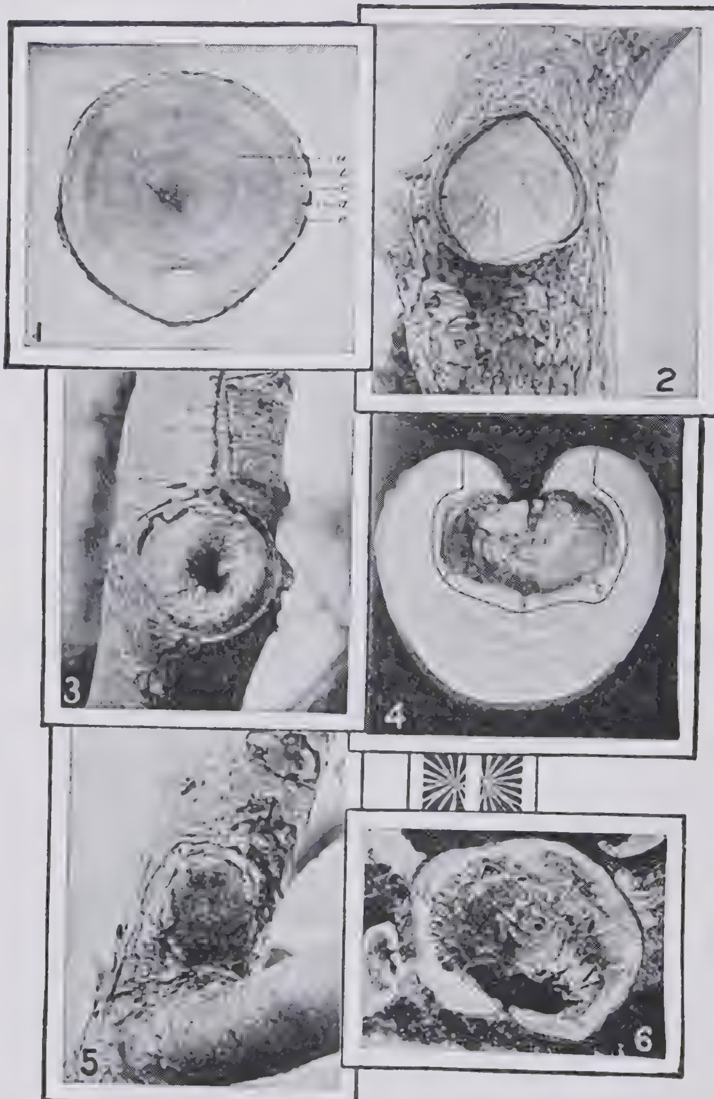


FIG. 228.—Pruning and tree surgery: 1. *a*, heart wood; *b*, sap wood; *c*, cambium or growing layer; *d*, inner bark; *e*, outer bark. 2. When a large limb is cut it should be sawed very close to the body so that the growing layer and bark can produce a new growth to cover it. The cut surface should be painted to prevent decay. 3. A new growth over an old wound leaves a deep hole at the center if decay begins too soon. 4. A cross section showing the affected part. 5. The growth in many cases may continue and almost or entirely hide the affected part. 6. A section showing the decayed heart wood commonly known as "hollow tree." (U. S. D. A.)

rant bushes. It passes thence to the white pine. In order to protect timber stands, therefore, including areas set in seedlings, owners destroy all currant and gooseberry bushes in the vicinity.

Pecans and Hickories.—Several Farmers' Bulletins discuss the diseases in the hickory, of which the pecan is a species. Other diseases of these trees are discussed in technical bulletins and circulars of the U. S. D. A.

Web Worms.—The fall web worm is very serious in hickories and in some other forest trees. Leaves are completely eaten off by the worms, which live in the webs and feed upon the foliage. When forests are seriously attacked this enemy may be controlled by spraying or dusting with arsenate of lead in the early stages of the attack. All leaf-eating insects may be controlled with poisons. Birds, if plentiful, will usually keep these insects down.

Tent Caterpillars.—There are two main types of this insect, the forest and the apple, both of which are found in a number of forest trees. They are usually more abundant in the spring and early summer, and are seldom found in the trees in late summer and fall. Full-grown tent caterpillars are larger than web worms. Their habits, however, are somewhat similar, and methods of control are much the same. Birds are less likely to keep down tent caterpillars because of their hairiness, but some species of birds attack them readily.

Plant Lice.—Aphids are often injurious to elms and some other trees. If they become serious on small trees, spraying with nicotine sulfate (one part to a thousand of water) may prove very profitable.

Protecting Bird Life.—Birds are among the best friends of the farmer. Most birds live on insects all or a part of the year. Enormous losses from insect ravages may be charged to the destruction of bird life. A farm woods should be an ideal place for birds; no better haven for them could be maintained by a farmer. From these woods birds may visit fields, gardens, and orchards, and will catch hundreds of thousands of insects, particularly during the nesting season.

U. S. Farmers' Bulletins 621, 755, 760, 844, and 912 give many suggestions for attracting birds. Lists of useful birds are given in 630.

Enemies of Birds.—Among the chief enemies of birds are boys and men with guns, squirrels, cats, and dogs. These enemies should be controlled whenever possible.

Job 9. Controlling Fires and Other Injurious Factors

Conditions Usually Found.—(1) Forest fires prevail in many sections during dry seasons. (2) Heavy losses result from forest fires.

Aims.—Students should learn the effects of forest fires; how forest fires are started; how fires may be prevented and controlled.

Problems for Study and Discussion

1. What losses may occur from forest fires?
2. How are fires started? How prevented?
3. What laws or regulations exist in your state against forest fires?
4. Write to your state forester for rules regarding fire prevention.
5. Get posters for use in "posting" a home woods.
6. Examine trees injured recently or in past years by fire.
7. Describe the injurious work of fires you may have seen.
8. Calculate the loss from forest fires during one season.
9. What forest insects follow fire injury?

Activities.—If possible visit forests or woodlands where fires have raged. Measure areas, count the trees, and estimate the losses due to fire.

Kinds of Injury.—Forest fires cause losses in several ways: (1) direct destruction of wood; (2) trees killed; (3) destruction of seedlings which would renew the forest; (4) injury of bark, allowing the starting of disease; (5) partial killing of trees, which encourages attacks of bark beetles and other insects; (6) checking of growth, which often causes premature harvesting; (7) destruction of ground cover and soil humus.

Millions of dollars are lost annually through forest fires. This is true in nearly every state in the Union. Surely it is true of every state with extensive forests.

Starting of Fires.—Forest fires are often started by a tourist or some campers. Picnic fires are not always extinguished and wind may scatter their sparks to leaf litter or ground cover, often causing serious conflagrations.

Dry weather encourages the starting and spread of fires.

Prairie fires sometimes spread into forests or farm woodlands. Hunters smoking or starting fires to rouse game may cause serious damage in forests.

Lightning during hot, dry periods may start serious fires, particularly among coniferous trees.

Deliberate setting of fires by farmers, who want to burn off litter and undergrowth with the idea of obtaining grass for grazing, is one of the commonest causes of forest fires. This is usually done through ignorance. Forest growth is of much greater value than a little grass in open places. The deliberate starting of fires to encourage grass growth is sometimes defended by farmers who do not realize that the undergrowth and ground cover are of more value in promoting tree growth than the grazing obtained. The ground cover maintains moisture which the trees need for their best growth, but burning the ground bare hastens both the run-off of rainfall and the evaporation of soil moisture, thereby stunting the tree growth.

Fire Prevention.—The best prevention of forest fires is general education of the public in the knowledge of trees and forests and of the losses incurred when they burn. The public should be instructed in what to do in all kinds of situations. Special instruction should be given on each of the points mentioned in the preceding topic.

Fire Laws.—Laws for prevention of forest fires exist in most states. Such laws not only tend to prevent the setting of fires but usually provide funds for suppressing them through a forest-fire control organization, a part of the duty of which is to post regulations, warnings, rules, and danger signals. In large forest areas lookout towers and telephone communication are often established to detect and report fires.

Controlling Fires.—Firebreaks are often established by leaving open areas around the timber and keeping these closely pastured with goats or sheep to prevent the growth of combustible material. Piling brush and other trash after forest products are cut is a valuable precaution against fires. Such material, even when piled, may be a dangerous fire hazard; in that case a sufficient amount of it should be burned during a damp period to remove the danger. Sometimes, however, smaller limbs and brush render best service when scattered, in helping to secure reproduction by protecting seedlings in their earliest stages.

Plowed strips around farm woods and shelter belts may aid greatly in checking the approach of prairie fires.

Back-firing is a good method of stopping the approach of severe fires. This usually consists of first raking a clean path as a fire lane at a safe distance in front of the blaze, and then setting fire along the edge of this path to burn back to the oncoming fire line.

Underground Fires.—In some cases, forest fires attack the peat and vegetation below the surface of the ground. When such fires become well established they may persist in spite of ordinary rainfall. Under extreme conditions, fires of this character may last for a year or more. Digging a ditch across the path of such a fire is the most effectual way of stopping its progress. In most cases heavy rains will extinguish underground fires. If such smoldering fires are not extinguished they may at any time break out into surface fires and cause much forest destruction. While they are burning underground, the soil is being injured, the surface is being lowered and many trees are being killed from beneath. Seeds and seedlings are killed outright.

Posting the Farm Woods.—Owners should be certain that their woodlands are properly "posted" with warnings against fires with state regulations regarding the extinguishing of camp fires and with penalties and warnings for careless people. Suitable posters and sets of rules may

usually be obtained by writing to the state forester at the capital of the state.

Wind Injury.—Trees are often broken, limbs broken, soil badly blown and the woods otherwise damaged by heavy winds. Heavy thinning is often a cause of wind injury; the trees should not be too sparse. Windbreaks and shelter belts should be compact and the planting should be close enough effectually to break the wind. In prairies or other open countries, thick stands of trees are more important, but the grower should always remember that trees will produce more valuable products when grown rather close together.

Sunscald.—In hot climates and to some extent in other places trees may be injured by sunscald. This usually occurs on the southwest side of unprotected trees such as maples, basswood, and black walnut. In farm woodlands and shelter belts this can be prevented by having an undergrowth along the southwest side of trees to produce shade during the afternoon. In many cases trees will protect themselves by their own limbs on the border of the area.

Drouth Injury.—In arid and semi-arid regions, and to some extent in dry seasons elsewhere, trees may suffer greatly from dry weather. Much of the damage may be prevented by constant cultivation or by using mulching materials, such as straw or hay, which conserve moisture. Mulching may not only protect trees in time of drouth, but may be of great value in preventing injury during severe freezes.

Job 10. Reforestation

Conditions Usually found.—(1) On many farms, woodlands have been cut over and are no longer profitable. (2) The owners of such areas often improve the stand of trees and maintain them as woodlands.

Aims.—Students should understand what problems are involved in reforestation and how to apply suitable methods.

Problems for Study and Discussion

1. If possible, locate cut-over lands which could well be reforested.
2. When trees are harvested, why should a few trees of seed-bearing age be left on each acre?
3. What do you mean by natural reseeding of cut-over lands?
4. What is meant by coppice growth?
5. What kinds of trees may be reproduced by coppice growth?
6. What is the value of protecting cut-over lands from goats, sheep, and other livestock?
7. What may be saved by starting a woodland on a former forest site?
8. Describe the mattock method of planting young trees in such an area.

Activities.—Draw a map of an area which should be reforested, showing the present location and kinds of growth. Indicate where new plantings must be "heavy," "medium" and "light." From this, estimate the number of trees to be started.

Value of Cut-over Lands.—When stump lands or areas containing considerable undergrowth are available, their use as a farm woods is usually economical. The cost of establishing a woodland on such a plot is usually much lower than on cleared land. In some cases there are enough seedlings or young trees and seed in the ground to produce a good stand if properly protected and managed.

Sometimes it is necessary to plant more seeds or to set seedlings. It may be necessary to thin parts of the young growth or to cut out undesirable species to permit better trees to thrive.

Fig. 229.—Red cedars reseeding in a deciduous wood lot. Note single parent tree in background. (Department of Horticulture, Kansas State College.)

Value of Old Seeding Trees.—If the original cutting was so planned as to leave a few good seed trees the area may be reseeded by them. A few trees undesirable for lumber are often left. The number of trees needed varies with the species; the seeds of some are carried long distances, and those of others fall near the trees. The owner must judge carefully the number of trees required to reseed the area. Save trees sound enough to withstand heavy winds; in some cases groups of trees instead of single trees must be left. Trees that scatter seed are maple, poplar, tulip, ash, willow, and conifer; trees scattering seed only short distances are walnut, oak, beech, chestnut, and hickory.

The Seed Bed.—When an area is to be reseeded, either naturally or artificially, it should be put into as favorable condition as practicable for receiving the seed. If the ground is torn up and exposed by logging or by farm implements, reseeding may result favorably. If, on the other hand, the area is badly infested with grass and weeds, seeds may have little opportunity for favorable growth and little or no reproduction will ensue. Pasturing with hogs before seeding may aid in putting the soil into favorable seed-bed condition.

Sprouts and Suckers.—Some trees reproduce themselves readily

by sprouts and suckers from live stumps. Cone-bearing trees having this capacity are rare, but, oaks, chestnuts, catalpa, willows, hickories, ash, and basswood are often found sprouting from stumps. Their ability to do this depends much upon the age and vigor of the cut trees. Trees from sprouts, called *coppice* growth, are not likely to live so long as trees from seed. Their early growth, however, is usually very rapid, and the production of posts and fuel by this method is often satisfactory. The method succeeds best when the old trees are cut in the dormant season, preferably in the latter part of winter or early spring. Sprouts starting at or below the surface of the soil are preferable to those on the sides of stumps. For this reason, stumps should be cut very low. Slanting cuts are best and the surface of the stump may be temporarily protected by painting, if desired.

Planting Seeds.—When seeds such as walnuts and acorns are to be planted, rapid methods should be devised. Seeds planted in the late fall will be aided in germination by the soil moisture and winter freezing. Small hand-bars with handles similar to walking-stick or spade handles may be used when the soil is soft. Small seeds sown in soil prepared by swine, as stated above, or by harrowing, may be covered by driving a flock of sheep over the area after seeding. If the soil is very loose, dry weather may be best for this purpose. If the soil is rather firm, the work may bring best results in wet weather.

Thinning.—There are two main purposes of thinning: (1) to keep the stand open enough for young seedlings to make proper growth. (2) to remove the undesirable trees to make room for desirable.

In thinning trees, the grower should remember that leaves need light. When branches are shaded, imperfect growth is the result. Some trees may be killed entirely by shade. Desirable seedlings may be killed by the shade of rapidly growing undesirable ones. The increase of wood is proportional to the leaf surface exposed to light. We should therefore make room for the trees which we want, by weeding out those which interfere.

Planting Seedlings.—In reforesting a woodland it is often necessary or advisable to plant seedlings among the trees standing on the area. The purpose may be to make the stand denser or to change it to another species.

The mattock is often used for setting young trees in a woodland where other trees are already growing (Fig. 227). A man with one stroke may make the hole into which his helper sets the seedling and tramps the dirt properly about the roots.

Protecting Young Growth.—Woodlands should never be exposed to the ravages of pasturing. Young seedlings will be destroyed and much

coppice growth may be injured. Tramping the ground may also be very injurious. It is the best policy to protect such areas from livestock by fencing.

Job 11. Harvesting Woodland Products

Conditions Usually Found.—(1) Lumber companies and others harvesting woodland products too commonly use unscientific methods. (2) Few farmers and other wood users realize the value of proper harvesting to perpetuate profitable timber growth. (Fig. 230.)

Aims.—The owner should understand the value and methods of scientifically harvesting his woodland products.

FIG. 230.—Careful harvesting of the wood crop will make the woodland permanent. (U. S. D. A.)

Problems for Study and Discussion

1. What forest products are most commonly harvested in your region?
2. What wasteful methods have you seen in woodlands?
3. Describe the bad effects of felling trees carelessly.
4. What is meant by mature trees?
5. Why are European forests managed better than those in America?
6. What precautions should be taken to provide for the natural reforestation of cut-over lands?
7. How does the method of harvesting affect the control of forest insects?
8. How does the cleaning up of waste brush at harvest time aid in controlling fires?
9. Debate harvesting mostly at one time vs. annual harvesting.

Activities.—Make a map of the home woodland, or one in the region, showing how it may be divided for a rotation system of harvesting. On each division indicate the cutting year and the kinds and amounts which should be harvested from the division.

Wasteful Methods.—Most wasteful practices are pursued in the uses of the farm woods and other woodlands. Trees are wantonly destroyed by careless felling; stumps are cut high; trees of moderate size are often left to decay or burn in the forest; skidways and roads are located without reference to the protection of young growth which should remain and reforest the area; logs of secondary value are often left after they are cut; tops, large limbs, logs, and even whole trees are left to the hazards of fire and to the attacks of bark beetles which multiply in such numbers as to attack the healthy trees and injure or destroy the entire growth. Too often forest fires are actually started or encouraged in their progress by woodsmen themselves, for the sake of covering up their own wasteful methods or of wantonly making a clearing. Great care should be exercised in harvesting.

Judging Maturity.—When forest trees are of proper age for cutting they are said to be "ripe for the axe"—mature for the harvest. The purpose for which the trees are grown may influence the determination of this age. For example, fence posts are cut from younger and smaller trees than lumber. The shape, quality or species, and health of the tree will also affect the time of cutting. The owner should try to use every tree to its best advantage; those which would greatly improve if left should not be cut; those in the way should be removed much younger than they otherwise would be. Only trees which will not make more valuable products should be used for fuel. A good rule is to cut trees when they will yield the highest money returns.

The presence of a temporary sawmill in the vicinity may lead the owner reasonably to cut trees which are barely mature enough for lumber, as it may be several years before another opportunity offers for the sale of saw logs. Market conditions also often affect the time of cutting. Where mines are near enough to create a demand for mine props, trees may profitably be cut from rather young coppice growth, and a continuous annual harvesting may be followed.

Felling a Tree.—Careful woodsmen fell trees in the direction they desire. They undercut with an axe on the side toward which the tree is to fall. The depth of cut depends on the tree; it should be made as low as possible. A cross-cut saw is usually used in cutting trees, operated by two men or a machine. Sometimes the bark is chipped off where the saw is to run. The saw cut is started on the side opposite the axe cut, and a few inches higher. Wedges are used behind the saw; these not only prevent

pinching but tend to throw the tree in the desired direction. A strong wind may affect the direction of fall. The men should remove the saw and move out of danger when the tree starts to fall, since the tree may kick back some distance.

To protect young growth near the tree, the direction for felling should be chosen with care. Sometimes the use of a rope is necessary to aid in felling the tree gently or to keep it from crushing saplings and other neighboring growth.

Trimming and Cutting Products.—Woodsmen should trim the trunks of trees closely and cut logs, poles, and posts into lengths indicated by owner or market. They should measure the trunk before cutting to determine into what lengths it can most economically be cut. Sometimes cuts can be made through knots or other defects so that these will be on the ends of the marketed logs. Cutting at the middle of a bend may reduce its bad effects. It is often possible and advisable to make a number of products from each tree so that all parts will be used to good advantage. Upper parts may be used for posts, railroad ties, and fuel, and the lower parts for saw logs.

Assembling Products.—Logs should be dragged to suitable places for loading on trucks, cars, or boats, or for sawing by temporary mills. Cordwood should be ricked ready for hauling. Brush and all waste parts should be gathered together in piles in open places to be burned, if advisable, where the fires will not destroy young growth. The burning of waste parts prevents the attacks of bark beetles. In Europe tops are made into bundles and burned as fuel.

Annual Harvesting.—When trees are mature in a woodland, they are ready for cutting for the products which are most desired in that region. If possible, the owner should plan to cut each year a part of the trees, those which are most mature, and allow others to mature year by year.

Annual cutting utilizes winter labor better than logging out the area severely all at one time.

Annual cutting brings in a steady money return and a regular supply of fuel as needed.

A Rotation Plan.—Large woodlands may be divided into three or four sections; one section to be harvested each year. This plan allows heavier cutting in each section and yet provides for the annual wood supply needed on the farm. The care of each section is easier as the owner knows when each one is to be cut over. He may do such trimming, thinning, and protecting of the slow growth as is necessary to give the desired results.

When harvesting whole blocks or sections that have been started at about the same time and are maturing somewhat together, enough seed-

bearing trees should always be left to reforest the area. Specimens may be selected for this purpose that are less valuable for lumber or other purposes and will bear an abundant supply of seeds for reforestation.

Insect-infested trees, regardless of size, should be removed to help control forest insects.

Job 12. Marketing and Using Products

Conditions Usually Found.—(1) Much marketing of woodland products comes from permanent clearing of land. (2) This causes a condition of irregular selling of products. (3) Only a few farmers regularly harvest railroad ties, posts, and fuel from their woodlands.

Aims.—(1) Students should try to systematize marketing of woodland products. (2) They should understand good selling methods and know how best to utilize the products.

Problems for Study and Discussion

1. Ascertain how many local farmers sell woodland products regularly each year.
2. What products are usually sold and at what prices?
3. What kinds of trees are cut for these purposes?
4. What are the markets to which these products are turned?
5. Describe conditions when temporary sawmills are brought into the region.
6. Compare this plan of marketing woodland products with the annual cutting and marketing.
7. What products of the woodland are used by farmers themselves?
8. Give directions for estimating the lumber in saw-logs.
9. What kinds of wood are usually preferred by local sawmills?
10. What sizes are demanded for telephone, telegraph, and electric-light poles? What woods are preferred?
11. How do prices compare for railroad ties cut from different kinds of wood grown locally?
12. Compare the values of fence posts made from different kinds of wood.
13. What timbers are preferred for mine lagging? What sizes are wanted?
14. What types of cordwood bring best prices?

Activities.—Practise measuring logs and estimating lumber in trees and logs Calculate the amount of lumber to be sold on a sample acre. Estimate the amounts and values of other woodland products.

Selling Saw-logs.—The value of saw-logs depends upon size, soundness, kind of wood, length, straightness, and conditions under which they were cut and handled. The amount of lumber in a log is estimated.

Measuring Logs.—A log table is helpful in estimating the number of board feet of lumber in a log. First, the top diameter of the log is determined with a rule, and, for logs that are sixteen feet long, four inches is subtracted and the remainder is squared. This gives the board feet of lumber in the log. The same rule is followed for shorter logs and then a part taken of this corresponding to the proportional length. A twelve-foot log would have three-fourths as many board feet as a sixteen-foot log. This rule may be followed for perfect logs. Allowances must be made for imperfections and no rule can cover all cases.

Selling by Measure.—When sawmills are in the vicinity and saw-

logs can be sold to the mill, it is best for the farmer to sell by the number of board feet in the logs. The prices received may depend upon the quality of the lumber, the kind of wood, and the quantity available. Sometimes lumber is sold "standing" and the owner of the mill does the cutting. This plan is usually unsatisfactory for the owner of the land, as reckless methods of cutting may be practised. If possible, the owner should attend to the harvesting and hauling of the logs. However, the hauling may be contracted for by either the buyer or the seller.

Effect of Temporary Sawmills.—When small sawmills are temporarily brought to a region, farmers are tempted to cut many logs which are not mature and which would produce much more lumber if allowed to

FIG. 231.—Jack and Scotch pines furnish combination windbreaks, bird and game refuges, and lumber. (Department of Horticulture, Kansas State College.)

grow several more years. This results in too severe thinning of woodlands, and much of the area is often so closely cut as never to be used for forest products in the future. Waste lands are found in many regions which tell this tale.

Annual Selling.—The greatest returns from a woodlot are obtained when products can be sold annually. If sawmills are not permanently located in the region or are not near enough to allow transporting sawlogs each winter by truck, railroad, or stream, the owner of the woodland should plan if possible to sell other products. Sometimes pulp mills may be readily accessible. Railroad ties usually bring good prices for suitable kinds of wood. Fence posts are usually in demand. Poles for electric power, telephone, and telegraph lines are easily sold. Wood for fuel brings

good prices in many regions (Fig. 232). Such products can be harvested from a woodlot each winter and sold when other farm products are not demanding the time and attention of the owner. Teams can be utilized which would otherwise be idle during winter seasons.

Products for Home Use.—Most farms need to cut woodland products for home use. Fuel from this source is usually cheaper than coal, oil, gas, or electricity, which must be purchased. Fence posts are often needed. Poles may be wanted for use in sheds, stacks or for use in private telephone lines.

Selling Poles.—Tall, straight trees are often cut for sale as poles to companies maintaining electric, telephone, and telegraph lines. Chestnut, yellow pine, and white cedar are the most popular kinds for this purpose, but others are often used. The sizes of poles are usually designated by the

Fig. 232.—Yard containing 60,000 posts and 650 ricks of stove wood cut from 20 acres of 16-year-old hardy catalpa trees. (Kansas State Agricultural College.)

lengths and diameters measured at the top and bottom. The demands for these sizes vary with conditions and the owner should inquire from those purchasing poles what requirements must be met.

Railroad Ties.—In many regions cross ties are readily sold. These can be cut from woodlands each winter and delivered at the most convenient railroad siding. Some variation in size and grade is allowed by buyers. White oak and locust have always been in demand for cross ties. The scarcity of these kinds of wood has induced railroad companies to use a number of other species. Hard maple, beech, birch, red oak, and others are more readily sold for this purpose than formerly.

Mine Props.—These are often called *lagging*. They are used to support mine roofs during mining operations. Usually the diameter must be three or four inches and the lengths must be cut to suit the particular mines which buy them, as the veins of material removed from mines differ

in different places. Suitable woods for this purpose are found in many regions. Those desiring to sell mine sticks should consult buyers as to kinds demanded.

Cordwood.—The value of different kinds of wood for fuel depends largely upon their burning properties. Maple, oak, hickory and other woods which are very heavy and hard bring the best prices. Split wood is considered better than round wood, as there is less sap wood in a cord. A cord of four-foot wood measures four feet high, four feet wide, and eight feet long. When cut into stove lengths, a cord is piled to a height of four feet and to a length of eight feet.

DIAGRAM SHOWING CROSS SECTION OF TYPICAL SHELTER BELT ON TEN ROD STRIP

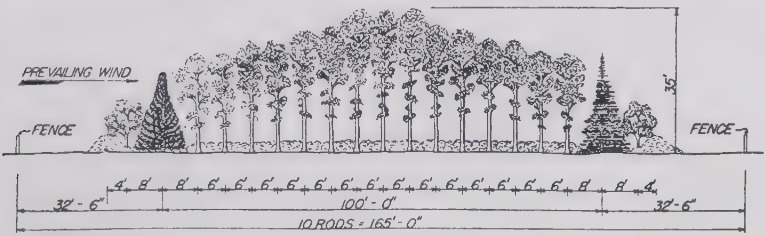


FIG. 232a.—Cross section of typical farm shelter belt planting. (U. S. Forest Service.)

Windbreaks and shelter belts serve the purposes of protecting stock and buildings from cold winds, and stock, buildings, and crops from hot winds in the summer. Their importance in the latter function has recently been the cause of the vast amount of this type of planting in the middle west and plains regions. There they also aid in preventing wind erosion, water erosion, and gullying, as well as furnishing all the advantages of a farm wood lot, including firewood, bird and small animal refuges, shade for livestock during the heat of the day, and picnic sites.

The Suggested Windbreak Plans are those in use in the Plains States and are proving satisfactory there.

CHAPTER XXI

IMPROVEMENT ENTERPRISES

Analysis into Jobs.—The teaching units in any type of horticultural improvement of the farm, home, or school may be considered under the following jobs. References are to U. S. Farmers' Bulletins. See *Rural Improvement*, Waugh.

1. Determining possibilities with horticultural and landscape improvements, 1087, 1132, 1227, 1448.
2. Making plans for the improvements, 497, 506, 621, 630, 760, 894, 912, 1456.
3. Listing materials needed, 1169, 1208.
4. Laying out the plans on the place, 444, 1481.
5. Buying and caring for plants, 1178, 1209, 1482.
6. Propagating shrubs, vines, and other plants, 157, 750, 1171, 1311, 1370, 1397, 1406, 1453.
7. Planting; executing other plans, 1209, 1452.
8. Realizing on the improvements, 1209.

Job 1. Determining Possibilities with Horticultural and Landscape Improvements

Conditions Usually Found.—(1) Very many farms need improvement. (2) Farmers who have systematically made improvements on their farms find it profitable and worth while from many points of view.

Aims.—(1) Students should learn the value of making improvements. (2) They should devise means of making improvements profitable. (3) They should readily recognize places which need improvement.

Problems for Study and Discussion

1. How can an improvement subject be made profitable?
2. What is the influence on members of a family of having good improvements on the place?
3. Compare two places,—one which has a well-planted farmstead and the other not, and see how their values compare.
4. Select and describe some unsightly features on farmsteads in your neighborhood.
5. What is the effect of improvements upon the attitude of neighbors and buyers toward a place?
6. If many summer tourists travel past a place, what are the influences upon them of having an attractive looking place?
7. If a roadside market is to be used in selling farm products, what effect upon it would a good-looking farmstead have?

8. What objections are found among your neighbors against improving their farmsteads?
9. If cost is the chief objection, how can that be largely overcome?

Planning Projects.—Young farmers and others can often gain much profit by making horticultural and landscape improvements on their farms. Run-down places, giving a bad appearance to the public and discouragement to members of families, may be greatly improved

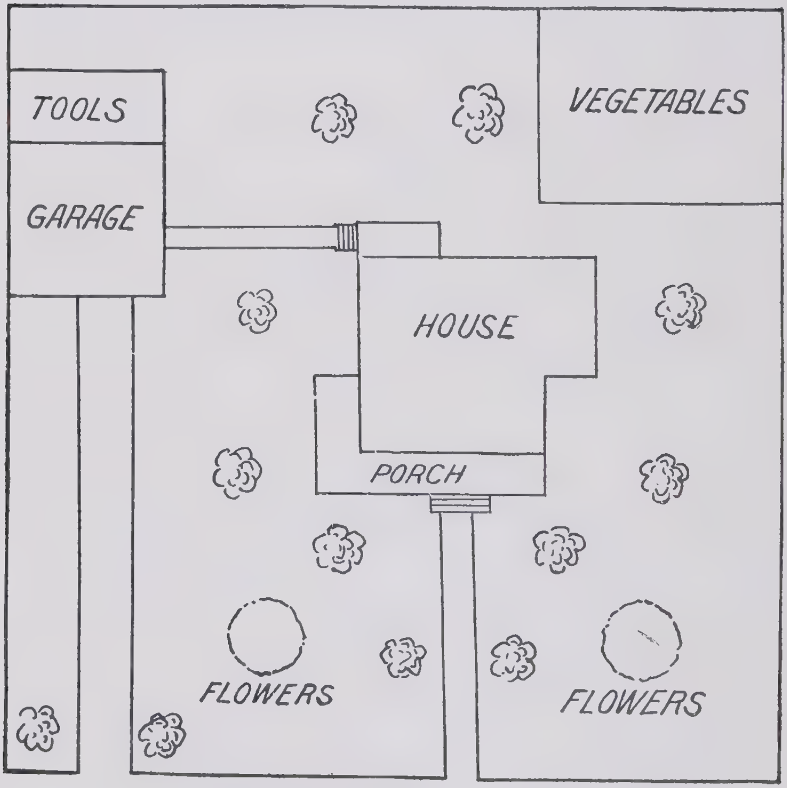


Fig. 233.—Showing poorly planned walks, drives, and planting.

by attention to walks, roads, fences, and the landscape planting (Figs. 233 and 234). A few vines may be grown to hide an unsightly outbuilding or other spot. Clumps of shrubs may be placed where they will be attractive and hide unattractive features. Foundation planting about the base of the house or along the steps may be a great addition and will

help the appearance of the place substantially (Fig. 236). Many homes can be found which need improvement (Fig. 235). Buyers are often attracted by suitable improvements of plantings.

Profits from Improvements.—If the son of a farm owner under-

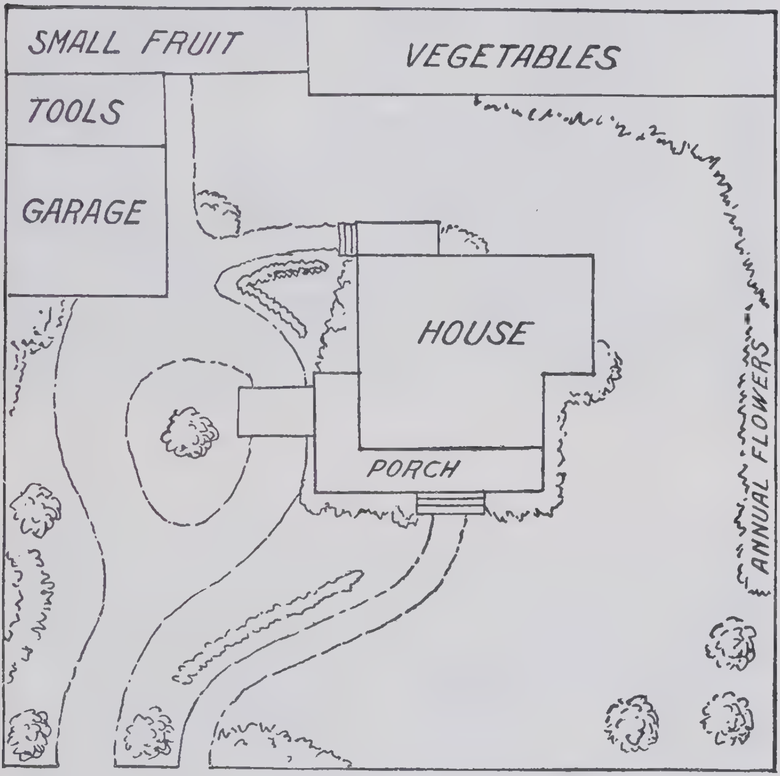


FIG. 234.—Same as figure 233, replanned, showing a much more attractive arrangement which adds considerably to the value of the place.

takes a project of this kind, agreements may be made whereby the improved value of the place may be credited to the son. The amount of improvement may be easily estimated by obtaining a bid on the land or by having an assessment committee appointed to value the land before and after improvements are made.

Job 2. Making Plans for the Improvements

Conditions Usually Found.—(1) Many people who wish to make improvements by planting shrubs, vines, or trees or by laying out walks are careless in making

Fig. 235.—A planting which has been neglected may be a detriment to a home. (Department of Horticulture, Kansas State College.)

Fig. 236.—Same home as that in figure 235 after plantings had been corrected. (Department of Horticulture, Kansas State College.)

plans. (2) Those who make careful plans in advance make their improvements more attractive and secure better results.

Aims.—(1) Students should learn how to make suitable plans for improvements. (2) They should know how to lay out the grounds to a scale, draw on the plans the permanent improvements, and fill in among these the improvements they are planning.

Problems for Study and Discussion

1. Make a list of reasons why plans should be made in advance of making the improvements themselves.
2. Find cases if possible where farmers have made planting but have made no plans regarding them in advance.
3. How would plans help you if you could not make all of the improvements in one year but wanted to make them through a series of years?
4. On what scale would you wish to draw a plan, showing the permanent buildings and other improvements for your farmstead?
5. What size of paper would such a plan require? What is the advantage of using cross-ruled paper?
6. For your place why would you prefer to include the whole farmstead in your plans rather than merely the house surroundings?
7. If the opposite is the case, give reasons.
8. Study U. S. Farmers' Bulletin 1132 on "Planning a Farmstead."
9. From this, learn how to indicate with a pen or pencil the different kinds of improvements or plantings.
10. Make a brief list of the most important planting which your place seems to need.
11. For what reasons is planting needed about the house?
12. For what reasons is planting needed about other buildings of the farmstead?
13. What places seem to need trees?
14. In what places are shrubs needed?
15. Where should vines be planted?

Activities.—(1) Secure sheets of cross-ruled paper of suitable size for your plans for planting your farmstead. (2) Take measurements of the sizes of buildings and their distances apart, indicating these on the cross-ruled paper. (3) Locate the roads, walks, fences, and other permanent improvements. (4) With the use of the above Bulletin, indicate where the trees are to be planted, where shrubs are to be planted, and where vines are to be planted.

In the planning a pen or a pencil of a different color may be used for those improvements which are not yet installed, and black may be used for the permanent features already located.

Why Make Plans.—There are several reasons why plans should be made before the actual improvements are installed.

1. This plan causes a more careful study to be made.

2. It is easier to see what present improvements need changing, if any.

3. It calls attention to measurements which are bad or which are satisfactory. If roads are too wide or walks are too narrow or too wide the plans will call attention to these errors, and the need of edging up walks and roads is emphasized.

4. Plans can be easily erased and changed, and the cost is nothing as compared with the changing of plans on the ground.

5. The whole problem is visualized, and efforts can be first directed where they are most needed.

6. The deliberate intentions of the owner are recorded so that they can be carried out from year to year through a series of years if necessary.

7. The problems which are to be carried out are more easily indicated to those who are to help in the work.

8. Future owners or others who are working on the place will more readily understand the plans and improvements to be carried out.

Fig. 237.—Nursery with overhead sprinkling system, Lane County, Oregon. (U. S. D. A.)

Many times plantings are made and roads and walks laid out with little idea of future improvement. The effects of the planting or laying out of the walks are not foreseen. Results are sometimes very bad when completed.

It often pays to plan the improvements for a series of years. Perhaps plants are to be propagated and are not ready for planting or are too small or the cost is too great for the present. Let the improvements be made at spare times, and thus the work may be carried on for a long time and interest in the place is maintained.

Principles of Planning.—Make the plans suit your ideals but be practical in all this work. Do not try to make roads up steep places. Let them wind around a gentle grade with beautiful curves and angles in roads

and walks (Fig. 238). Let shrubbery be grouped in masses rather than scattered about the grounds. Plan for plantings of shrubbery which you feel will be permanent rather than temporary. Do not let this interfere, however, with planting of annuals for quick effects at first. You can hide an unsightly corner and give a beautiful effect with annual plants.

FIG. 238.—Graceful drives and walks and effective grouping of native shrubs and trees combine here to make a place of which to be proud. (U. S. D. A.)

Let the plans show a spirit of liberality rather than a crowded effect. Plans should reflect the spirit of the owner and should show his sense of beauty. The comfort and convenience of the people of the household should be considered always. Let steps, roads, walks, garages, and all be convenient for the use of the people.

Planting to Suit Buildings.—If the house or other building is tall, do not put a Lombardy poplar tree or other slender growth nearby. Plant broad-headed trees to balance the stilted effect of the building. If the house is low and spreading, the tall slender growth may be used with better effect. Notice the harmony of residence and large trees in figure 239. Massing shrubs has already been mentioned. This plan helps to blend the lines of buildings with the smooth lawn surface. Evergreens, for example, can be left unpruned to the ground. Their lines of beauty will blend harmoniously with their surroundings. Never leave any bare

FIG. 239.—A high house on a hill is much relieved by large trees about it. Clumps of shrubbery to hide the base would be a great improvement. (Photo by Waugh.)

corners unprotected by shrubbery. Some one has said that when we fail to plant shrubs along the bases of buildings we give the effect that it needs clothes, because it seems to be bare-footed. All the plants should be so effective as to embellish the surroundings (Fig. 240).

Landscape Effects.—The location of roads and walks is sometimes bad and should be corrected. The size of the garden or its location may be changed in some cases. Protection of buildings from bad winds or making better openings to the sunlight is sometimes needed. The appearance of the home may often be greatly helped by proper planting of vines, trees and shrubs.

Grouping vs. Scattered Effects.—Trees and shrubs should not be scattered promiscuously over the surface of the lawn. They should be planted with a definite scheme in mind. Trees should be planted

FIG. 240.—Clumps of spirea are attractive when in flower and can be used on farms, city home lots, and public grounds. (Department of Horticulture, Kansas State College.)

FIG. 241.—Tree butchering rather than careful pruning is often seen in towns and cities. The trees which have been "pruned" are permanently injured.

where they will give proper background, frame attractive views, and shade walks, roads, and buildings. Do not try to shade the entire surface of the lawn with trees. The best authorities on landscape gardening recommend planting shrubbery in masses. It may be used around foundations (Fig. 240), along the edges of yards, in corners, at the angles of walks and sometimes at the curves in roads. Tall shrubbery will give a feeling of privacy and screen undesirable surroundings. Low shrubbery is chiefly for embellishment. Thorny shrubs such as dwarf barberry and Japanese rose take the place of fences or require people to follow walks instead of cutting across lawns (Fig. 242). Leave a beautiful greensward to be mowed and give a neat appearance to the place.

FIG. 242.—A striking example of formal gardening, with grass plots laid off in geometric forms by the growth of evergreens and privet hedge, which takes the place of fences.

Vines are used to break the monotony of bare walls and soften the hard lines of projecting corners (Figs. 243–244). Vines on trellises will hide unsightly buildings or obscure the view of bare lots or gardens. Vines should be selected to suit their particular purpose. For pergolas, arbors, wooden or wire trellises, use such vines as clematis, grapes, climbing roses, wistaria, Virginia creeper, Madeira, and such annual vines as Japanese bean, morning glory, cyprus vine, gourd, and prickly cucumber. On fences or buildings of cement, brick or stone, use Boston ivy, English ivy, and Englemann's ivy. These are also good on old tree trunks or stumps. English ivy is evergreen and grows slowly. The others make much more rapid growth, but lose their leaves in winter.

Grouping Trees.—Even trees may be grouped so that they will give an effect of massing after they have become large. When trees are scat-

tered over the lawn it is difficult to mow the lawn with a horse mower or with a hand mower. They are always in the way of the machine and they are in the way of seeing the beautiful things you have planted. Better leave some plain greensward as part of the canvas of your picture. Put the trees as you do the shrubs, at the corners, angles, and along the borders. There is no objection to planting some straight lines of trees along roads, fences, etc. These straight lines may be broken occasionally; at least at the ends they may blend into masses of shrubbery.

Job 3. Listing Materials Needed

Conditions Usually Found.—(1) Many people plant with little attention to the right kinds of varieties for the particular place or purpose. (2) Careful selection of shrubs, trees, and vines produces much better effects whenever improvements are made.

Aims.—(1) Students should learn to know the effects of different kinds of trees, shrubs, and vines. (2) They should know how to use the right ones in the right place. (3) They should know how to choose flowering plants with the proper colors to suit the environment.

Problems for Study and Discussion

1. What common shrubs are found in the plantings on farms or homes near you?
2. What other shrubs could well be added and used to advantage in your region?
3. What vines are commonly used locally?
4. What other vines could well be used in your region?
5. Mention suitable kinds of supports for vines of different kinds.
6. Compare different vines in their rapidity of growth.
7. What trees are best for shade in your region? Which of these are slow growing and which rapid growing?
8. What kinds of trees would be best for planting along the side of the public road? Give reasons.
9. What shrubs are best for home plantings?
10. Which woody plants are best for landscaping the home grounds in your vicinity?
11. Compare materials for use as whitewash or paint on fences, outbuildings, and houses.
12. Compare rock gardens with informal plantings.

Activities.—(1) Send for catalogs from nurseries and seed houses which supply flower seed, shrubs, vines, trees and other plants. (2) From these catalogs and from your studies make up lists of plants of different kinds for your farmstead.

Shrubs to Plant.—It is well for the owner to select shrubs native to his region. What is more beautiful as a shrub than the wild rose, wild blackberry, wild elderberry, and others which may perhaps be transplanted from their nearby wild surroundings?

There are a number of other shrubs that are always popular and much to be desired. Lilac, spirea (Fig. 240), syringa, golden bell, deutzia, althea, hibiscus and others may be purchased at low prices and can be afterward greatly multiplied by easy methods. Many of these may be grown by hardwood cuttings taken in the winter.

For hedges use such plants as California privet, Chinese privet, hem-

lock, cedars, lilac, Japanese quince, and Osage orange. Most of these can be trimmed to any form desired and made to produce dense growths. Some of these are sometimes used as formal plantings in parks.

Boxwood shrubs may be used either as ornamental clumps or for hedges. The growth is extremely slow, but the beauty will compensate for waiting.

Vines to Plant.—Vines have several ways of climbing. Always choose those vines that will climb upon the object which you are trying to cover. Do not make the mistake of trying to make twining vines climb on stone walls or buildings. Give each its natural way of climbing, and

FIG. 243.—The panicled clematis is a perennial vine, producing a beautiful bower of white flowers in late summer and fall.

it will save you much effort in trying to make it ascend to the heights you desire. Good plants for stone or brick surfaces are Boston ivy, English ivy and Englemann's ivy, and Virginia creeper on fences.

A good vine to cover dead trees, stumps, and wooden buildings is trailing burning bush (*Euonymus radicans*). Virginia creeper and trumpet vine are fairly well suited to such locations.

Vines for wire trellises are the grape, wisteria, Virginia creeper, Virginia clematis, pannicled clematis (Fig. 243), Madeira vine, the beans of various kinds, such as Japanese bean (Lablab) and velvet bean. Sometimes it is necessary to change the kind of support to suit the vine. If vines are already growing near some building a pole may be erected or a wire may be stretched up to accommodate them.

Annual vines should often be used where quick effects are desired. Among these might be mentioned cypress vine, gourds (Fig. 244), wild cucumber, morning glory, the different kinds of climbing beans, and moonvine. Where perennial kinds can be started at the same time this should be done to avoid having to replant each year and wait for the growth each season.

Trees to Plant.—For quick effect, rapid growths are sometimes desired. Cottonwoods or poplars are sometimes used where shade must be produced quickly. Remember that the trees which grow fast are seldom permanent; they will die young. For more permanent growths we would probably select elms, maples, oaks, and other slow growing kinds.

Among those which grow rather quickly and are also rather permanent may be mentioned walnut, hardy catalpa, hickory, and tulip tree.

Fig. 244.—Gourds are annual vines which may be used to make a quick screen. (U. S. D. A.)

For wet places we would select willows, swamp maple, sycamore, alder and others growing naturally along the water's edge of streams.

Perennial Flowers from Seeds.—Many perennial flowering herbaceous plants may be quickly grown from seeds. If the seed bed is planted in August and the young seedlings are soon transplanted, well watered, and nourished during the first autumn, they may be expected to show some bloom the next season. They will become stronger and produce more flowers each year. (See Farmers' Bulletins nos. 1567, 1591.)

Prepare the soil by spading in a place that is partially shaded. Drill the seeds in rows a few inches apart. Cover very slightly by sifting soil over them and gently packing. Water well. Transplant the seedlings soon after they form their second pairs of leaves. It may be well to

Botanical Name	Common Name	Height	Bloom	Color	Remarks
Achillea millefolium	Common Yarrow	24 in.	5– 7	White	Border, full sun, fine foliage
Achillea ptarmica..	Sneezewort	18 in.	5– 7	White	Border, full sun, fine foliage
Ajuga reptans.....	Carpet Bugle	6 in.	5– 6	Blue	Shade, edging
Althea rosea.......	Hollyhock	70 in.	6–10	Variegated	Full sun
Alyssum saxatile...	Goldentuft	12 in.	3– 4	Yellow	Full sun, rock garden
Anchusa italica....	Italian Bugloss	48 in.	5– 7	Blue	Sun or shade, wet
Aquilegia canadensis	American Columbine	24 in.	3– 4	Yellow-red	Partial shade, rock garden
Aquilegia hybrids..	Hybrid Columbine	30 in.	4– 5	Variegated	Partial shade, border
Arabis albida......	Wallcress	6 in.	3– 4	White	Full sun, rock garden
Asclepias tuberosa..	Butterflyweed	20 in.	6– 7	Orange	Dry soil, sun
Aster hybrids......	Hardy Aster	9 in.-38 in.	6–11	Variegated	Sun, good soil
Baptisia australis..	Wild Indigo	30 in.	5– 6	Blue	Dry soil, sun
Boltonia asteroides.	White Boltonia	50 in.	7– 9	White	Sun
Callirhoe involucrata	Low Poppy Mallow	8 in.	5– 9	Rose	Dry soil, sun
Campanula persicifolia	Peachleaf Bellflower	28 in.	5– 6	Blue	Partial shade, cut flowers
Centaurea montana	Mountain Bluet	24 in.	5– 9	Blue	Border
Cerastium tomentosum	Snow-in-summer	6 in.	5	White	Full sun, edging
Chrysanthemum coccineum	Painted Daisy	18 in.	5– 6	Variegated	Partial shade, drainage
Chrysanthemum hardy	Hardy Chrysanthemum	28 in.	9–10	Variegated	Full sun
Chrysanthemum maximum	Shasta Daisy	24 in.	6– 7	White	Sun or partial shade
Convallaria majalis	Lily-of-the-Valley	8 in.	4– 5	White	Shade, moist
Coreopsis lanceolata	Lance Coreopsis	36 in.	5– 6	Yellow	Full sun, border
Daphne cneorum...	Rose Daphne	12 in.	3– 4	Rose	Full sun, drainage
Delphinium hybrids	Hybrid Larkspur	40 in.	4– 9	Blue	Sun, rich, cool
Dianthus barbatus.	Sweet William	18 in.	5– 6	Variegated	Warm, drained
Dianthus plumarius	Grass Pink	8 in.	4– 5	Variegated	Warm, drained
Dicentra spectabilis	Bleedingheart	18 in.	3– 4	Rose	Partial shade
Echinacea purpurea	Purple Coneflower	24 in.	6– 7	Rose	Sun, poor soil
Gaillardia aristata..	Gaillardia	20 in.	5– 9	Yellow-red	Sun, dry soil
Gypsophila paniculata	Baby's breath	30 in.	6– 7	White	Sun, dry soil
Gypsophila repens..	Creeping Gypsophila	6 in.	5– 6	White	Sun, rock garden
Hemerocallis flava..	Lemon Daylily	28 in.	5– 6	Yellow	Shade or dry
Heuchera sanguinea	Coralbells	18 in.	5– 7	Red	Partial shade
Hosta caerulea.....	Blue Plantainlily	18 in.	8– 9	Blue	Shade
Hosta plantaginea..	White Plantainlily	24 in.	6– 7	White	Shade, large flowers
Iberis sempervirens	Evergreen Candytuft	10 in.	4– 5	White	Sun, edging
Iris germanica.....	German Iris	30 in.	4– 5	Variegated	Sun, dry
Iris pumila.......	Dwarf Iris	8 in.	3– 4	Blue-yellow	Sun, dry
Iris sibirica........	Siberian Iris	28 in.	5– 6	Purple-white	Sun, moist
Liatris pycnostachya	Cattail Gayfeather	40 in.	7– 9	Purple	Sun, dry
Lobelia siphilitica..	Large Blue Lobelia	20 in.	7– 9	Blue	Partial shade, moist
Mertensia virginica	Virginia Bluebells	18 in.	4– 5	Blue	Partial shade, moist
Oenethera missouriensis	Ozark Sundrops	10 in.	5– 9	Yellow	Sun, dry
Paeonia officinalis..	Common Peony	30 in.	5– 6	Red-white	Sun, good soil
Papaver nudicaule..	Iceland Poppy	12 in.	4– 5	Variegated	Sun, good soil
Papaver orientale..	Oriental Poppy	34 in.	5– 6	Red	Sun, good soil
Pentstemon torreyi.	Torrey Penstemon	60 in.	6– 7	Red	Shade, good
Phlox divaricata...	Wild Sweet William	10 in.	4– 5	Blue	Sun, partial shade
Phlox sublata......	Moss Phlox	6 in.	3– 4	Variegated	Sun, partial shade

Botanical Name	Common Name	Height	Bloom	Color	Remarks
Phlox suffruticosa..	Garden Phlox	30 in.	6– 7	Variegated	Sun, good soil
Physostegia virginia	False-Dragonhead	38 in.	6– 9	Pink	Sun, moist, dry
Platycodon grandiflorum	Balloonflower	28 in.	6– 8	Blue	Sun, sandy loam
Plumbago larpentae	Plumbago	10 in.	7–10	Blue	Sun, dry soil
Salvia azurea-grandiflora	Azure Salvia	28 in.	8– 9	Blue	Sun, dry
Sanguinaria canadensis	Bloodroot	6 in.	3– 4	White	Shade
Saponaria ocymoides	Rock Soapwort	10 in.	5– 9	Pink	Sun, any soil
Scabiosa caucasia . .	Caucasian Scabiosa	18 in.	6– 9	Lavender	Sun, drainage
Sedum spectabile . .	Showy Sedum	18 in.	7– 9	Rose	Sun, any soil
Stokesia laevis.....	Stokesia	18 in.	6–10	Blue	Sun, light soil
Thalictrum aquilegifolium	Meadowrue	34 in.	5– 6	White	Shade, drainage
Tradescantia virginiana	Virginia Spiderwort	36 in.	5– 6	Blue	Shade, moist
Tunica saxifraga...	Tunicflower	7 in.	6– 9	Pink	Sun
Veronica spicata...	Spike Speedwell	18 in.	5– 9	Blue	Sun
Vinca minor.......	Common Periwinkle	7 in.	4– 5	Blue	Partial shade
Viola cornuta......	Tufted Pansy	6 in.	4–10	Variegated	Partial shade
Viola odorata......	Sweet Violet	7 in.	5– 6	Violet	Partial shade, good

shift them a second time to the distance indicated in the table. Protect them with a light mulch of strawy manure when the ground begins to freeze.

Spring flowering perennials are given somewhat in order of blossoming dates: anemone, bloodroot, rockcress, spring beauty, hepatica, wake-robins, shooting star, candytuft, forget-me-not, peony, the smaller phloxes, columbine, lily-of-the-valley, bleedingheart, iris, violets, pansies.

Summer and Autumn Perennials.—Tall anemone, blue columbine, mallow, harebell, Canterbury bell, Scotch pink, Japan iris, blazing star, oriental poppy, perennial phlox, yucca, hollyhock, daylily, flame flower, cardinal flower, coreopsis, hardy chrysanthemum, golden glow, goldenrod, and Jerusalem artichoke.

Annual Flower Borders.—The accompanying table gives important points regarding some common annual flowers. These are useful for beds and borders. The seeds may be carefully sown in beds of rich sandy loam in hotbeds, cold-frames, or in the open (Figs. 245 and 246), later in the spring. The seedlings are nearly all improved by transplanting. Cover seeds by sifting soil over them to a depth of one-eighth to one-fourth inch. Water them often and protect them from drying winds, hot sun, and severe cold nights. The distances between plants at shifting time should be governed by the effects desired and by the heights of the plants.

Other annual flowers are here listed in groups by their most common colors:

White flowers: Dianthus, iberis, poppy, stocks.

Yellow flowers: Cacalia, calendula, celosia, coreopsis, hibiscus, mignonette, nasturtium.

Blue flowers: Ageratum, centaurea, lobelia, mimulus.

FIG. 245.—This bed of Portulaccas (annuals) takes little space and no time after the first planting, but yields beauty and pleasure for an entire season. (R. I. State College, Ext. Dept.)

FIG. 246.—The vegetable garden whether at home or at school may be bordered with annual and perennial flowers. (R. I. State College, Ext. Dept.)

Red flowers: Adonis, agrostemma, cacalia, celosia, Clarkia, dianthus, gaillardia, nasturtium, saponaria, stock.

Many colors: Godetia, mirabilis, nigella, pansy, sweet pea.

Planting Table of Annual Flowers

Name of Flower	Height of Plant (Inches)	Blooming Season	Color	Best Use
Ageratum	5–18	July to frost	White, blue, rose	Carpeting
Alyssum	3–12	End of June to frost	White	Borders
Aster, dwarf	6–12	August to frost	All colors	Solid beds
Balsam	12–30	July to frost	Pink, white, cream	Borders
California Poppy	12	July to frost	Yellow, white, red	Ribbon beds
Candytuft	6–12	End of June to frost	Assorted	Borders
Cosmos	30–60	July to frost	Many colors	Background
Marigold	6–36	July to frost	Yellow	Dwarf for borders; tall for beds
Petunia	10–18	August to frost	White, blue, striped	Carpeting
Phlox, annual	4–12	July and August	All colors	Ribbon beds
Portulacca	6	August to frost	Good assortment	Carpeting
Verbena	8–10	August to frost	Several colors	Carpeting
Zinnia	4–36	August to frost	All colors	Dwarf for borders; tall for beds

Plant List.—Following is a list of plants for home planting. It includes those most easily grown ornamentals for planting the home grounds. These are suitable for use in both north and south.

Shrubs

Berberis thunbergi . . . . Japanese Barberry
Buddleia variabilis . . . . Butterflybush
Cornus alba . . . . Tatarian dogwood
Cydonia japonica . . . . Flowering Quince
Forsythia suspensa . . . . Golden bell
Hibiscus syriacus . . . . Rose of Sharon
Hydrangea paniculata . . . . Bush hydrangea
Ligustrum amurense . . . . Amur privet
Ligustrum vulgaris . . . . Common privet
Lonicera morrowii . . . . Morrow honeysuckle
Philadelphus grandiflora . . . . Mock orange
Rhamnus cathartica . . . . Buckthorn

Shrubs (Continued)

Rhus canadensis.......................... Fragrant Sumac
Rhus typhine.......................... Staghorn Sumac
Spiraea van Houttei.......................... Van Houttes spirea
Symphoricarpos vulgaris.......................... Coralberry
Syringa vulgaris.......................... Common lilac
Tamarix africana.......................... Tamarisk

Vines

Ampelopsis quinquefolia.......................... Virginia creeper
Celastrus scandens.......................... American Bittersweet
Clematis Jackmanii.......................... Jackman clematis
Clematis paniculata.......................... Clematis
Climbing roses
Climbing American Beauty — Dorothy Perkins
Crimson Rambler — Tausenschon

Evergreens

Trees

Juniperus virginiana.......................... Red cedar
Pinus Austriaca.......................... Austrian Pine
Pinus divaricata.......................... Jack Pine
Pinus ponderosa.......................... Western Yellow Pine
Pinus sylvestris.......................... Scotch Pine
Pseudotsuga douglasii.......................... Douglas-Fir

Shrubs (Semi-evergreen)

Juniperus commonis.......................... Common juniper
Lonicera fragrantissima.......................... Winter honeysuckle

Vines

Lonicera halliania, var. japonica.......................... Hall Japanese Honeysuckle
Rosa wichuraiana.......................... Memorial rose

Roses

Cut flower types: Frau Karl Druschki, General Jaqueminot, Hadley, Killarney, Marshal P. Wilder, Mrs. Aaron Ward, Ophelia, Paul Neyron, Richmond, Ulrich Brunner, and many others.

Rosa setigera.......................... Prairie Rose

Flowers

Bulbs (spring)	Bulbs (summer)
Crocus	Canna
Hyacinth	Dahlia
Narcissus	Gladiolus
Tulip	Tiger lily

PERENNIALS (old-fashioned flowers)

Aster	Garden pink
Bleedingheart	Goatsbeard
Carpathian harebell	Hardy phlox
Columbine	Hollyhock
Common yucca	Iris
Coreopsis	Oriental larkspur
English daisy	Oriental poppy
Evening primrose	Peony
Foxglove	Periwinkle
Gaillardia	Shasta daisy
	Sweet William

This list of plant material is by no means complete; however, it contains plants which have proved perfectly hardy and which may be successfully grown with a reasonable amount of care.

Woody Plants for the Home Grounds

TALL TREES

Acer saccharum	Sugar Maple
Betula nigra	River Birch
Celtis occidentalis	Hackberry
Diospyros virginiana	Persimmon
Fraxinus lanceolata	Green Ash
Gleditsia triacanthos	Honey Locust
Gymnocladus dioica	Kentucky Coffeetree
Hicoria pecan	Pecan
Juglans nigra	Black Walnut
Platanus occidentalis	Sycamore
Populus varius	Cottonwood
Prunus serotina	Wild Black Cherry
Quercus alba	White Oak
Quercus imbricaria	Shingle Oak
Quercus macrocarpa	Mossycup Oak
Quercus palustris	Pin Oak
Quercus rubra	Red Oak
Robinia pseudoacacia	Common Locust
Salix amygdaloides	Peachleaved Willow
Salix longifolia	Longleaf Willow
Salix nigra	Black Willow
Tilia american	Basswood
Ulmus americana	American Elm

SMALL TREES

Aesculus glabra	Ohio Buckeye
Asimina triloba	Papaw
Cercis canadensis	Redbud

Woody Plants for the Home Grounds (Continued)

Small Trees (*Continued*)

Prunus americana	American Plum
Sapindus drummondi	Western Soapberry

Evergreen Trees

Juniperus virginiana	Red Cedar

Large Shrubs

Aesculus arguta	Texas Buckeye
Amorpha fruiticosa	False Indigo
Cephalanthus occidentalis	Button Bush
Cornus asperifolia	Gray Dogwood
Cornus stolonifera	Red Osier Dogwood
Evonymus atropurpureus	Wahoo
Ilex decidua	Deciduous Holly
Rhamnus caroliniana	Carolina Buckthorn
Rhus glabra	Smooth Sumac
Salix discolor	Pussy Willow
Sambucus canadensis	Black Elderberry
Staphylea trifolia	American Bladdernut
Viburnum lentago	Sheepberry
Viburnum prunifolium	Black Haw

Medium Shrubs

Ribes aureum	Golden Currant
Ribes missouriense	Missouri Gooseberry
Rosa arkansana	Arkansas Rose
Rosa setigera	Prairie Rose
Rhus aromatica	Aromatic Sumac

Small Shrubs

Amorpha canescens	Leadplant
Ceanothus americanus	Jersey Tea
Symphoricarpos occidentalis	Western Snowberry
Symphoricarpos vulgaris	Coralberry

Heavy Vines

Ampelopsis cordata	Heartleaf Ampelopsis
Ampelopsis quinquefolia	Virginia Creeper
Bignonia radicans	Trumpet Creeper
Celastrus scandens	American Bittersweet
Vitis cinerea	Winter Grape
Vitis cordifolia	Frost Grape
Vitis vulpina	Riverbank Grape

Light Vines

Clematis fremontii	Fremont Clematis

Clematis ligusticifolia . . . . Western Clematis
Clematis pitcherii . . . . Native Clematis
Clematis virginiana . . . . Virgin's Bower
Menispermum canadensis . . . . Moonseed
Smilax hispida . . . . Bristly Smilax

Some Good Ornamental Trees

Evergreens

Botanical Name	Common Name	Height
Abies concolor	White Fir	30–40 feet
Juniperus virginiana	Red Cedar	30–40 "
Picea canadensis	White Spruce	50–70 "
Picea canadensis—albertiana	Alberta Hills Spruce	50–70 "
Picea excelsa	Norway Spruce	50–65 "
Picea pungens	Colorado Spruce	30–40 "
Pinus nigra	Austrian Pine	50–85 "
Pinus ponderosa	Western Yellow Pine	50–75 "
Pinus strobus	White Pine	50–65 "
Pinus sylvestris	Scotch Pine	50–65 "
Pseudotsuga douglasii	Douglas-Fir	50–70 "

Deciduous

Acer dasycarpum	Silver Maple	50–70 "
Acer platanoides	Norway Maple	40–60 "
Acer saccharum	Sugar Maple	50–70 "
Celtis occidentalis	Hackberry	50–70 "
Cercis canadensis	Redbud	10–20 "
Crataegus crusgalli	Cockspur Thorn	15–25 "
Crataegus mollis	Downy Hawthorn	15–25 "
Elaeagnus angustifolia	Russian-Olive	20–30 "
Fraxinus americana	White Ash	50–60 "
Fraxinus lanceolata	Green Ash	50–60 "
Ginkgo biloba	Ginkgo (Maidenhair Tree)	40–50 "
Gleditsia triacanthos	Honey-locust	30–50 "
Gymnocladus dioica	Kentucky Coffeetree	35–45 "
Liriodendron tulipifera	Tuliptree	50–80 "
Mactura pomifera	Osage Orange	20–30 "
Malus ioensis	Prairie Crab	15–25 "
Platanus occidentalis	Sycamore (Plain tree)	60–80 "
Populus deltoides	Southern Cottonwood	65–100 "
Populus nigra italica	Black Poplar	50–75 "
Quercus alba	White Oak	50–80 "
Quercus macrocarpa	Mossycup Oak	50–80 "
Quercus palustris	Pin Oak	50–80 "
Quercus rubra	Red Oak	50–80 "
Tilia americana	American Linden	40–60 "
Ulmus americana	American Elm	50–70 "
Ulmus pumila	Chinese (Dwarf Asiatic) Elm	30–40 "

Rock Gardens.—Rock gardening gives an opportunity of using flowering plants not adapted to other types of gardens. Small plants of fine-textured foliage and dainty flowers are apt to be crowded out of the perennial border by more vigorous plants. Creeping plants that are so well suited to rocky slopes are usually quite unwelcome among choice perennial flowers.

Frequently steep banks and irregular areas where weeds and objectionable grasses flourish are found about the home. If provision is made for the growing of suitable rock plants on these unsightly areas, it is possible to transform them into spots of rare beauty and charm.

In these days of great industrial strife and intense living, many are losing sight of the importance of natural beauty. At present, formality seems to prevail as a choice of style in gardening efforts. Is not too much stress laid on this kind of gardening? Well-constructed rock gardens are small areas of great natural beauty, capable of breaking up the monotony and rigidness of many rather formal home grounds.

This type of garden is not limited as to size; it may occupy only a few square feet of space or it may take up most of the garden area, to suit the fancy of the grower.

In creating rock gardens great skill is necessary to make them appear as part of the natural soil formation. They look best in informal or natural areas where a background of natural vegetation forms an ideal setting.

Rock gardens should have an east or north exposure. The warmest and most trying rays of the sun come from the south and west, so that if the garden slopes in either of these directions, the sun's rays would be at right angles to the slope. Under such exposure the plants suffer in both summer and winter. In order to make the back look as natural as possible it should, at some points, be steep with a vertical ledge showing the strata of rock somewhat characteristic of the natural formation in the vicinity. In other parts it might well be less sloping to give diversity and interest to the area. A fairly satisfactory average slope is one foot vertical to two feet horizontal, or an average angle of 45°. However, many beautiful rock gardens have been constructed on comparatively flat areas. It is important that the area should be broken enough to provide fairly quick drainage, for "wet feet" are not conducive in most cases to healthy rock plants.

Only native rocks, most common to the area, should be used in this type of garden. Rough ledge rocks, such as are seen in natural outcroppings, should be utilized. It is seldom that waterworn stones are found in banks, and almost never in great quantities.

One must remember that he is providing a suitable place in which to grow plants rather than creating a museum of geological specimens.

Many owners of so-called rock gardens are really proud to tell one that their "rock pile" contains specimen rock from each state in the Union and perhaps from several foreign countries. In many of these collections no two rocks are similar in any respect and could not be worked into a beautiful rock garden unless they were buried in the soil so as not to be seen.

The rocks should not all be the same size but should range from sizes not smaller than one foot in length to not larger than three to four feet in length. Small stones are always difficult to arrange naturally.

Good soil is as important in this kind of gardening as in any other. Soil that is similar in composition to a mixture of one-third good garden loam, one-third sand, and one-third well-rotted manure is ideal for rock plants. Heavy clay soils should never be used, for they bake very hard and dry and swell when wet and are apt to heave the plants when they freeze.

Great care must be used in constructing a rock garden. One cannot expect results by dumping the rocks on to a bank. He must lay each stone thoughtfully if the garden is to be a success. First of all, provision must be made for soil pockets where the plants can grow normally. The rocks should be placed so that ample soil is in the intervening spaces. The soil pockets should be V-shaped so that the soil will settle back into place should it dry out or heave slightly from freezing. The largest stones should be placed at the base of the slope first. All of the rock should be slightly tilted into the bank so that the rain water will flow back into the soil rather than off over the rocks. Soil should be worked in between the rocks as they are laid. In some cases it will be necessary to push the soil back under or between the rocks by means of a blunt stick or ram. It is important that no air pockets be left in the soil or under the rocks if moisture is to be retained uniformly through the soil. Where one large stone is placed on another it should be held up by small stones to provide a layer of soil between the rocks and to take the weight off rocks above.

When rocks are used that have been taken from natural banks or from partially buried positions, they should be placed in the rock garden with the same face exposed. It would take a longer time than the average life of a person to produce the natural weathered appearance of a rock, should it be placed with the underside up. It is usually advisable to construct the garden several months before time of planting. This allows the rock and soil to settle.

Plants for the rock garden consist of small hardy perennial flowers, small shrubs, and dwarf evergreens. Annuals should seldom be used unless they are small and compact, such as sweet alyssum. The foliage of rock garden plants should be fine textured and compact or graceful in habit of

growth, such as the sedums and dwarf phlox. They should neither be weedy in character nor so rank in growth that the foliage will cover other valuable plants. Vines should be used sparingly if at all.

Early spring is the best season of the year for planting. The plants will have an opportunity of getting well established during summer months to carry them through the first winter without serious damage. Pot-grown perennials are best to plant, for they can be set into soil pockets without disturbing the root system materially. It is seldom advisable to start plants in the rock garden from seed.

After the plants have become established, the rock garden calls for but little care. It is important that the weeds and grasses be kept weeded out and wide-spreading plants be cut back frequently. There are times when the less permanent and tender plants will have to be protected in winter or possibly replaced by more hardy specimens.

By careful selection of plants as to season of bloom, one may have continuous bloom throughout the growing season.

One must keep large trees forty or fifty feet away from the rock garden if he would have the best results. Small trees, such as the redbud, blend well into the garden and add a bit of variety and naturalness to the effect.

It takes several years to bring the rock garden to completion, but after it is well established it will be found to be one of the most interesting and fascinating types of garden. Each year the garden will appear more natural than the preceding one, and likewise will be increasingly enjoyable to the diligent gardener.

Some Perennial Rock Plants

Achillea tomentosa (Woolly Yarrow)
Ajuga reptans (Carpet Bugle)
Allium cernuum (Nodding Onion)
Alyssum saxatile (Goldentuft)
Aquilegia canadensis (American Columbine)
Arabis albida (Wallcress)
Arabis alpina (Alpine Rockcress)
Aster alpinus (Rock Aster)
Aubrieta deltoidea (Common Aubrieta)
Callirhoe involucrata (Poppy Mallow)
Campanula carpatica (Carpathian Bellflower)
Cerastium tomentosum (Snow-in-summer)
Daphne cneorum (Rose Daphne)
Dianthus deltoides (Maiden Pink)
Dianthus glacialis (Ice Pink)
Dianthus plumarius (Grass Pink)
Gaillardia aristata (Common Perennial Gaillardia)

Gypsophila repens (Creeping Gypsophila)
Helianthemum chameacistus (Common Sunrose)
Iberis sempervirens (Evergreen Candytuft)
Iris cristata (Crested Iris)
Iris pumila (Dwarf Iris)
Linum Perenne (Perennial Flax)
Oenothera missouriensis (Ozark Sundrops)
Opuntia (Prickly pear)
Phlox amoena (Amoena Phlox)
Phlox divaricata (Blue Phlox)
Phlox subulata (Moss Phlox)
Plumbago (Plumbago)
Polemonium reptans (Creeping Polemonium)
Sanguinaria canadensis (Bloodroot)
Saponaria ocymoides (Rock Soapwort)
Sedum acre (Goldmoss)
Sedum album (White Stonecrop)
Sedum kamtschaticum (Orange Stonecrop)
Sedum middendorffianum (Middendorff Stonecrop)
Sedum reflexum (Jenny Stonecrop)
Sedum sexangulare (Hexagon Stonecrop)
Sedum sieboldii (Siebold Stonecrop)
Sedum ternatum (Mountain Stonecrop)
Sempervivum arachnoideum (Spiderweb Houseleek)
Sempervivum globiferum (Globe Houseleek)
Sempervivum soboliferum (Hen-and-Chickens)
Tunica saxifraga (Saxifrage Tunicflower)
Verbena canadensis (Rose Verbena)
Veronica repens (Creeping Speedwell)
Veronica rupestris (Rock Speedwell)
Viola cornuta (Tufted Pansy)

Hardy Bulbs for Rock Gardens

Chionodoxa lucilae (Glory-of-the-snow)
Colchicum automnale (Autumn Crocus)
Crocus vernus (Common Crocus)
Galanthus nivalis (Snowdrops)
Muscari botryoides (Grape Hyacinth)
Narcissus bulbocodium (Petticoat Daffodil)
Narcissus poeticus (Poets' Narcissus)
Scilla sibirica (Siberian Squill)
Tulipa gesreriana (Common Tulip)

Dwarf Shrubs for Rock Gardens

Amorpha canescens (Leadplant)
Berberis, dwarf species (Barberry)

Dwarf Shrubs for Rock Gardens (Continued)

Caryopteris incana (Bluebeard)
Ceanothus americanus (Jersey Tea)
Cotoneaster horizontalis (Rock Cotoneaster)
Cotoneaster microphylla (Rockspray)
Deutzia gracilis (Slender Deutzia)
Mahonia aquilfolia (Oregon Hollygrape)
Potentilla fruiticosa (Shrub Cinquefoil)
Spiraea, dwarf species (Dwarf Spirea)
Symphoricarpos vulgaris (Coralberry)

Dwarf Evergreens for Large Gardens

Juniperus chinensis-sargenti (Sargent Juniper)
Juniperus communis depressa (Prostrate Juniper)
Juniperus communis-montana (Mountain Juniper)
Juniperus horizontalis douglasi (Waukegan Juniper)

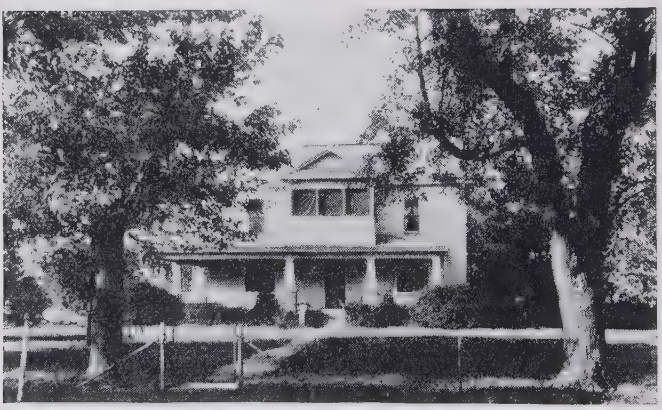


Fig. 247.—Shrubs and well-cared-for trees have made this a comfortable farm home. (Department of Horticulture, Kansas State College.)

Job 4. Laying out the Plans on the Place

Conditions Usually Found.—(1) Too often laying out the plans on the place takes the place of making permanent plans on paper. (2) Many who try to lay out plans on the place are deceived by distances and get proportions very badly placed. Beginners and others with little experience are unable to conceive the sizes of flower beds and the sizes of plantations unless they have used plans on paper.

Aims.—(1) Students should be able to follow blue-prints or other drawings and lay out plans on the grounds so that planters can follow them. (2) They should learn to designate the kinds of plants by the particular kinds of stakes so as to guide those who are to work in planting the plants and laying out walks and roads. The proper marking of stakes must be understood.

Problems for Study and Discussion

1. Why lay out the grounds with stakes? Give advantages.

2. When several kinds of shrubs are to be planted among each other, why would you use stakes of different color or of different size?
3. How can you use stakes to designate the line and grade of a terrace?
4. How can you mark stakes to indicate the cuts and fills along a road which is to be made?
5. Suppose you wish the planter to use some judgment in scattering plants among each other. How can you designate the kinds and numbers to be used without having a stake for each one?
6. Show how you can use strings or wire along a roadside with stakes to designate the border of the road or the edges of a walk or the borders of a flower bed.
7. When should stakes be placed when planting is to be done?
8. Who should do this staking?
9. When blue-prints or other drawings are to be interpreted, why should you know the scale before doing the staking?

FIG. 248.—A new home is made immediately more attractive if carefully planted. (Department of Horticulture, Kansas State College.)

Why Lay Out the Plans on the Ground.—Staking out the ground helps the owner or manager to know how roads, walks, flower beds, and other plantings are going to look before the actual work is done. It aids the workmen who are to do the actual planting to get the materials and plants in the right places. It gives an opportunity for changes to be made, if desired, before the work is actually performed. You are better able to know just how the number of plants you have are going to suit the planting plan. You may wish to reduce the number in one place and increase it in another.

Planting in the Right Place.—Stakes of several sizes, several colors, several materials, and several shapes may be made in advance. Certain ones may designate trees, for example, the large stakes. Others may represent vines,—medium-sized stakes. Others may represent shrubs,—the small stakes. Some of the stakes may have the upper ends

dipped in whitewash or in engine oil or in other coloring material. Mark on these what they are to designate also by writing the work or the kind on the stake. The planter will soon learn what each type of stake represents and what he is to put there.

Terraces.—When terraces are to be marked by grade stakes, the line at the base of the terrace may be made of small stakes. Indicate the height of the terrace by placing tall stakes where the bench will end. A line may be stretched along the stakes to indicate the top edge of the bench or a line of marks may be put along the stakes after they are driven so that the soil will be placed at the proper heights.

Roads, Walks, and Beds.—Use stakes with string or light wire to designate the curvatures of roads, walks, and beds. By this means you can indicate the curves better, and curves may be changed to suit the actual conditions. Driveways and walks are usually curved, or at least give a much more pleasing effect when they are curved.

When to Stake the Ground.—The owner, manager, or other expert should stake out the ground just ahead of the planting, only a day or so in advance. Stakes are likely to be moved or broken down if they are placed too long in advance of planting. In one section of the grounds the stakes may all be placed, and others be placed as the work advances.

Interpreting Drawings.—Any person who is interpreting a blueprint or other drawing must be careful to note the scale to which it has been drawn. If the scale is one-fourth of an inch, or one-eighth of an inch, or perhaps one-sixteenth of an inch to the foot, proper interpretations must be made. If the scale is not clearly indicated on the drawings, it is not difficult to make a trial or two to see whether the measurements which you believe are meant would be reasonable or not. Try it on the width of a road or the width of a walk or on the distance from the front door to the front gate. See how the interpretation suits the distances, and then write the scale plainly and conform to that in staking out the rest of the grounds.

Job 5. Buying and Caring for Plants

Conditions Usually Found.—(1) Many people buy their trees, shrubs, and vines from nurserymen, either through catalogs or otherwise. (2) Materials for walks, roads, and other improvements are usually purchased locally.

Aims.—(1) Students should understand how and when to order trees, shrubs, vines, and plants from nursery catalogs. (2) They should understand what materials are best and how to buy economically for building walks, roads, fences, and terraces.

Problems for Study and Discussion

1. From advertisements in agricultural papers or elsewhere make up a list of nurseries from which you can secure catalogs.
2. Write for catalogs from a number of these.

3. Write up lists, showing the numbers of each of the shrubs, vines, and trees which you wish to buy.
4. Note from the catalogs whether to designate the size or the age or the height in ordering the plants.
5. See how the prices vary according to the ages and sizes of plants.
6. Why should the color of flowers be considered when you are choosing your list of plants?
7. How early would you order your plants if you wish them for spring planting?
8. Why should you write a letter with the order, indicating second choice of plants?
9. Discuss the plan of allowing a nurseryman to make substitutions without your indicating the kinds to substitute.
10. Calculate the quantity of cement, sand, and gravel required for a walk.
11. Why should plants be unpacked and heeled-in promptly upon arrival from nurseries?

Use of Catalogs.—A number of nursery catalogs will be very helpful in making up a list of the shrubs, vines, and trees to be ordered. It should be noted that the prices per plant are lower when large numbers are ordered. It pays, therefore, to get more plants of one kind than to buy smaller numbers of the greater number of kinds. This plan need not spoil the effect in the planting, as the plants may be distributed over the premises so as not to give a monotonous effect. For example, forsythia may be ordered in great numbers and may be planted in a number of places, a few in a place. The early yellow bells, shown in the spring blossoms, will be very attractive even if there are only a few in a place.

It should also be noted by studying the catalogs that the prices are lower for small plants and for young plants. Some catalogs designate the age and others designate the size or the height. For quick effects, of course, large plants should be ordered; but for economy it usually pays to buy younger and smaller plants.

Colors of Blossoms.—Be sure to designate the colors of the blossoms in varieties which have more than one color. Bad mistakes may be made if this is not done. Altheas are of two or three main colors. If you ordered the wrong color and planted them, the colors might not harmonize with the surroundings. Avoid planting red flowering plants near brick walls of a red color. The shades of red do not harmonize and hurt the eye; the effect is very unpleasant. It seldom pays to plant white flowering plants near a white wall. More conspicuous colors are desirable there. Study color schemes carefully and make your list accordingly.

Ordering Early.—Let the nursery have your order as early as possible. Allow several months, if you can, before the shipments are to be made. Place your orders for spring delivery by midwinter. This rule is most important when large orders are placed. You are more apt to get what you want, and substitutions are less likely to be necessary.

Second choices should be designated where you are in doubt as to the nursery having enough of any one kind. Allow the substitution of a few

plants of a different color or of some other plant which is closely related. This can be designated at the bottom of the order sheet or in a separate letter enclosed with the order.

Allowing Substitutions.—It seldom pays to allow a nurseryman to make substitutions unless you designate what they may be. The nurseryman does not know your local surroundings. He does not know where you are planning to plant the various plants. If orders are made early there may be time for correspondence regarding possible substitutions if a nursery cannot fill the order exactly. You can indicate this in your order and ask him to tell what things he cannot supply fully.

Materials for Cement Walks.—If a walk is thirty feet long, three feet wide, and four inches thick, the number of cubic feet of concrete material will be thirty cubic feet. This does not include the cinders or foundation material below the walk. In calculating the quantity of gravel, sand, and cement for such a walk, the owner should order enough gravel to fill the space, thirty cubic feet. Then he should order enough sand to fill the voids in the spaces between the particles of gravel. As a rule it will take about three-fourths as many cubic feet of sand as of gravel. The quantity of cement to order would be enough to fill the voids in the particles of sand. This is about one-third to one-half as much as the sand. Each bag of cement is the equivalent of one cubic foot. If the formula for the mixture is four parts of gravel, three parts of sand, and one part of cement, this order would consist of thirty cubic feet of gravel, about twenty-two cubic feet of sand, ten or fifteen sacks of cement. Besides this, a little extra sand and cement might be ordered for the top coat, which is an extra-rich mixture, usually two of sand to one of cement. This is spread on top, about one-half inch thick.

Materials for Driveways.—In ordering cinders, loose gravel, or crushed stone to be spread loose between curbs or edgings for driveways, quantity of material to order depends largely upon the foundation upon which this material is spread. If the roadway is well drained and has a good curved surface with gutters at the sides, the thickness may be less than if the drainage is poor. The quantity is calculated according to the thickness, the width, and the length of the road.

Heeling-in Plants.—When vines and trees have been shipped from nurseries, the shipments should be delivered as promptly as possible and should be unpacked immediately. As soon as the packing material is removed, put the plants in trenches and cover the roots with soil. This is called heeling-in the plants. They may be left in this condition until they are to be planted in permanent places. Heeling-in prevents the drying out of roots, and the plants are much more apt to live.

Job 6. Propagating Shrubs, Vines, and Other Plants

Conditions Usually Found.—(1) Few farmers propagate their own shrubs, vines, and flowering plants. (2) Those who propagate their own plants are inclined to do more planting than others who have to buy from nurseries.

Aims.—Students should understand simple and easy methods of propagating the common shrubs, vines, bulbs, and flowering plants.

Problems for Study and Discussion

1. Describe the division of plants by dividing the roots.
2. Tell what hardy plants of your region may be propagated in this way.

Fig. 249.

Fig. 250.

Fig. 249.—The Christmas rose (Helleborus) is propagated by dividing the crown and roots.

Fig. 250.—The common peony is propagated by dividing the fleshy roots. These seldom grow without the crown buds.

3. Describe the propagation of plants by hardwood cuttings.
4. Give examples of plants propagated in this way.
5. What are soft or green-wood cuttings?
6. Give examples of ornamental plants propagated in this way.
7. What is propagating by layering? Describe.
8. Give examples of plants propagated by layering.
9. Review propagation by cuttings, the grape, bush-fruit and woodland enterprises.

Important Conditions.—A great many perennial herbs and woody shrubs have buds near the crown, just beneath the surface of the ground.

In nearly all such cases the plant may be dug up and the parts separated by splitting, cutting, or otherwise dividing the underground parts.

Roots bearing some of the buds near the upper part will be likely to grow when properly planted in a new place. The important point is to have some healthy buds with plenty of root surface (Fig. 249).

Herbs Propagated by Root Division.—Among the numerous herbaceous perennials which are readily propagated by this method are asparagus, rhubarb, some columbines, golden glow, lily-of-the-valley,

Fig. 251.—The beautiful pulsatilla is divided easily. Keep a bud and some root with each part.

peony (Fig. 250), hardy chrysanthemum, pulsatilla (Fig. 251), marsh marigold, bleedingheart, larkspur, gold seal (Fig. 252) and others. Many of these have true stems underground.

Shrubs Propagated by Root Division.—Those shrubs which have root-stocks or stolons running out a short distance can easily be propagated by division. Many hardy garden roses are of this type. The Japanese rose (*Rosa rugosa*) is an excellent example. Other such common

shrubs are barberry, spirea, some species of dogwood, common lilac, red raspberry, and sweet syringa.

Suckers.—These are underground stems with shoots sent up at a short distance from the parent plant. These may be taken up with enough root for their support and may then be set out as new plants. Some types of cherries may be propagated by this method. The multiplication of red raspberries, already mentioned, is really of this type. The silver-leaved poplar is one of the worst trees about sending up too many suckers; their real roots send up shoots.

Fig. 252.

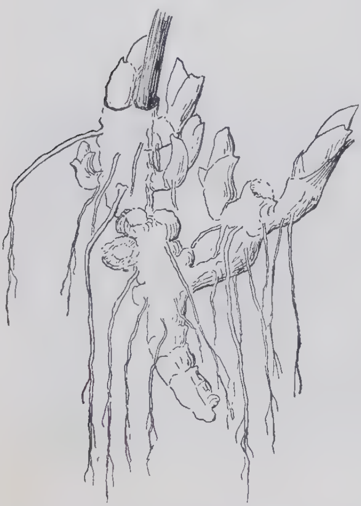


Fig. 253.

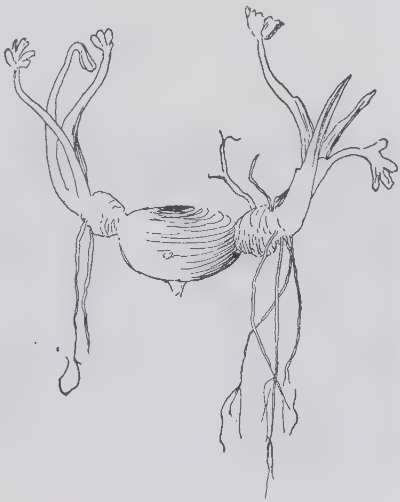


Fig. 252.—Gold seal (Hydrastis) is multiplied by tearing the roots apart and keeping crown buds on each part.

Fig. 253.—The old bulb of the bulbous buttercup will die and leave the young plants separated. This method of propagation may be hastened by separating the young bulbs from the old.

Dividing and Transplanting.—Probably the best time to divide plants, either herbs or shrubs, is in the late autumn, after the leaves have fallen. The whole plant may be taken up with plenty of its roots. The dividing may be done by means of a sharp spade, and by spreading the main parts until they separate. It is usually not necessary to treat the wounds in any way except to cover them with soil.

The divided plants should be set in their new places without delay.

Propagation of Bulbous Plants.—Propagation of plants by means of bulbs is sometimes called separation because the bulbs are vegetative organs that are naturally detachable.

Using Bulbs of Different Types.—*The solid bulb*, as found in the cyclamen of the greenhouse and the Indian turnip of the woods, is sometimes called a *corm*. Gladiolus (Fig. 254), crocus, and bulbous buttercup (Fig. 253) are other familiar examples. These solid bulbs reproduce themselves by forming new ones on top or on the sides of the old one, which dies away after its store of nourishment is used.

The true bulb is typified in many of the lilies. It is more like a very large bud with very thick, fleshy scales. The store of nourishment is chiefly in the scales themselves.

The coated bulb is seen in the common onion and hyacinth. The coats are in the form of rather complete rings. Hyacinth bulbs, if cut in sections or crosswise, will form small bulbs along the cut surfaces. These may be separated and grown to full size.

Fig. 254.—Gladiolus growing at a nursery, Sumter, South Carolina. (U. S. D. A.)

In the commercial propagation of hyacinth bulbs the strongest bulbs are selected. The bulbs are cut across or hollowed out, or are cut deeply as if to make sections. They are then dried and stored through the summer and then put into sandy soils. One season is sufficient for the formation of numerous bulblets which start at the cut places. These are separated and planted in specially prepared beds. They are here given good care and allowed to grow to full flowering strength, which may require from three to six years.

The bulbs grown by this method are propagated in large quantities in Holland, where the weather is moist, the soil favorable, and the winters not severe. Similar favorable conditions are found on the Pacific coast of Washington; and in recent years the bulb-growing industry has greatly increased in the region of Bellingham and elsewhere.

Bulblets are small bulbs formed above ground. On plants of the onion family they are near the tops of the stems like a flower cluster. On tiger lilies they are in the angles of the leaves along the stems. If separated from the parent plant and placed in the soil, they produce new plants.

Tubers are used for propagation of all plants which yield them. The most common examples of tuber-forming plants are the Irish potato and the Jerusalem artichoke. A tuber is a fleshy portion of the underground stem, bearing "eyes" or true buds arranged in somewhat regular spirals. From these buds the new growth starts.

Propagation by True Roots.—Very few plants can be propagated by true roots alone. Plants of the blackberry group are very notable examples. Methods used in propagating blackberries are described in the discussion of cuttings.

The peony and some other fleshy-rooted herbaceous plants, including the sweet potato, will grow somewhat readily from the fleshy roots.

The apple, pear, quince, and some plums are quite commonly propagated by means of root grafts. But in this type of propagation the new twig with its buds is grafted on the root or piece of root. A rather complete union is formed before the new plant begins growth. Root-grafting is fully described in the apple enterprise.

Job 7. Planting; Executing Other Plans

Conditions Usually Found.—(1) When proper plans have been made and planting actually begins, some farmers still make mistakes in planting. (2) Many owners plan to make plantings and other improvements about the place and fail to execute the plans.

Aims.—(1) Students should know how properly to plant trees, shrubs, and vines to secure successful growth. (2) They should understand how to organize workmen for the building of walks and roads and making of other improvements.

Problems for Study and Discussion

1. Give directions for digging holes for planting trees and shrubs.
2. Why should holes be made larger than the roots of the plants seem to require?
3. Why should holes be dug before tree roots are exposed to the air?
4. Give directions for setting a tree and filling in soil.
5. Discuss seasons for planting trees, shrubs, and vines in your region.
6. Why should the plants be watered at setting time? How is this done?
7. Give directions for edging gravel walks and roads.
8. Outline the steps for making concrete walks.

Tree Holes.—For planting trees and shrubs, holes should be dug before the roots of the plants have been exposed to the air. A number of holes should be made in advance and the planting may be done in time to prevent the soil from drying out badly. Make the holes larger than the tree roots require. This allows plenty of loose, black soil to be placed

about the roots and gives an opportunity for new growth to start in friable soil. Trees and shrubs should usually be planted only slightly deeper than where they were dug.

Setting the Plants.—The best season for setting plants is in late fall or early spring. Usually more favorable soil conditions prevail in the fall. If large trees are set in the fall, they should be braced to prevent wind causing them to form pockets about the large roots and main stem. Such bracing is often desirable even when trees are set in the spring.

When setting a tree or shrub, place it so the top is in an erect position and gives the appearance which you desire. Place some rich topsoil beneath the roots. Then add more topsoil on the roots and tamp it firm. Other soil may then be used to fill the hole nearly to the top. In many regions it is advisable to leave a little depression about the tree or shrub to gather some extra moisture when rains fall. Some loose soil should be placed on top of the last tamping of soil to prevent packing and cracking. A person can soon become expert in planting trees and shrubs and the work may be pushed along rapidly.

Edging Walks.—Many driveways and walks are made of cinders or broken stones. These are inexpensive but serve the purpose of keeping vehicles and pedestrians out of the mud. Such walks and roads should be edged with some suitable structure which will prevent the spread of the road material. Stones or brick are often laid on edge for this purpose. Sometimes a concrete curbing is used. Roads and walks so edged give a much better appearance and are much more valuable than without this finishing touch. The cost may be very little and the effect very good.

Walks.—Walks and short roads should usually be straight. The surface of the road itself may be of cinders, gravel, macadam (oiled or bituminous), or concrete, according to the kind of use and the funds available.

Walks should be built of durable materials, which are convenient and pleasant to walk upon. Gravel or cinder walks are inexpensive. Board walks are temporary and costly in the long run. Flagstones if laid closely and evenly will last for a very long time and frequently give very pleasing effects. Stepping stones about eighteen inches apart, except for very short distances, should be avoided. They are used when dry trails through otherwise wet grass are needed. For ordinary purposes the best walks are made of concrete. Expense in making concrete walks may be saved by reducing the width and occasionally the thickness. Have a good foundation of cinders, sand, and gravel. Never try to reduce expense by making a poor mixture of concrete. Rich mixtures will pay better in the long run. One of cement to three of sand and gravel will make a good walk. The surface may be one to two.

Job 8. Realizing on the Improvements

Conditions Usually Found.—(1) Owners who make improvements are often found to reap the benefits themselves by living more contentedly on the place. (2) In many cases farms are sold at increased prices because of improvements made.

Aims.—(1) Students should learn to profit by improvements made. (2) If they have pursued improvement projects, they should be able to calculate the benefits derived.

Problems for Study and Discussion

1. Compare places which have been improved recently with places which badly need improving.
2. Get a reputable citizen to compare two such places and set a value due to the improvements made.
3. Compare costs of improvements with the actual increased value of each place.

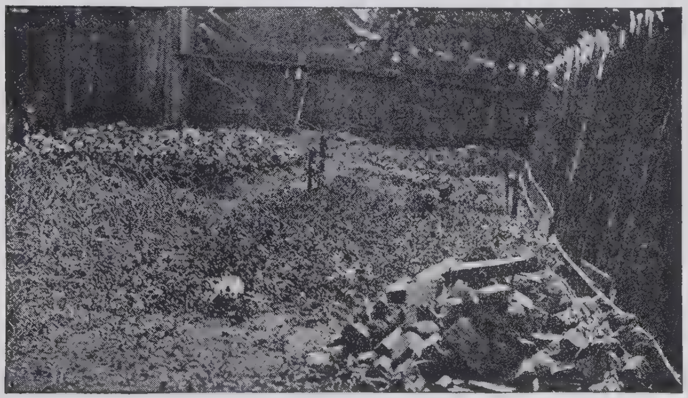


Fig. 255.—Gardening in back yards and vacant lots is good home-project work. It is sometimes conducted under difficulties.

4. Try to get offers on the place after improvements are completed.
5. Take pictures of the improvements made and compare them, if possible, with pictures which were taken before they were made.
6. Write an account of the improvements made, make a list of the things planted, and offer this with a picture to a local editor or to the editor of a state paper.
7. If possible, enter a contest with other people in your region and have the places judged by competent persons.

Appreciating the Benefits.—When successful plantings have been made and growth shows a marked improvement in the home grounds, and when roads, fences, and buildings have been improved, the owner should realize upon the benefits which these improvements should bring. The members of the family and friends should appreciate these improvements. Lawn parties may be given so that neighbors may be invited and allowed to enjoy the improvements.

Publicity.—Articles should be written which give the cost, the list of plants planted, the time which was used in making improvements, and

the incentives which led up to the work; and pictures taken before and after the improvements were made should be shown. Such articles and pictures may be published in state and local papers. National magazines are often glad to get such material.

FIG. 256.—The home-improvement contests helped to transform unsightly places into attractive yards.

Increase in Price of Land (Fig. 257).—Real estate men and other land owners often make a business of buying run-down places, improving

FIG. 257.—Trees, vines, and shrubs not only add to the beauty of the farm home and insure comfort to people and live stock, but actually increase the sales value of the farm.

them, and re-selling them. Farm owners can afford to get offers on places before the improvements are made and then get other offers on them after the improvements have been completed. Students who have participated in these improvements or who have carried them on as project work may

be given a definite interest in the farm as a result of these improvements. The amount of increase per acre in price of land due to the improvements should be the basis of calculation. Teachers and students should consult with farmers in advance regarding this plan of compensation for making improvements.

Contests.—In some regions contests are started in the improvement of home grounds (Figs. 255 and 256). In such cases, estimates are made before and after the improvements. Pictures are taken before and afterward. The costs are calculated in each case. The effects of each line of improvement are carefully studied. Judges are usually appointed to make comparisons. Prizes are sometimes awarded.

APPENDIX

FUNGICIDES AND INSECTICIDES*

Fungicides are materials used to kill bacteria and fungi that cause plant diseases. Insecticides are materials used to kill insects that attack plants.

Fungicides

Bordeaux Mixture.—Bordeaux mixture is the best spray for controlling leaf diseases of garden plants, the potato leafhopper on both beans and potatoes, and as a deterrent against flea beetle attack. It is very important that gardeners realize that this mixture is a preventive and not a cure, and that consequently it must be applied before, or as soon as, the very first signs of injury are seen. A 4–4–50 mixture is used on most crops, but where this strength injures the leaves, a 2–4–50 mixture is recommended. Bordeaux mixture can be purchased in convenient packages from seed dealers, or a better spray can be made more cheaply at home as follows:

Bluestone (copper sulfate)......	4 pounds	or	4 ounces
Quicklime (stone lime).........	4 pounds		4 ounces
or hydrated lime............	6 pounds		6 ounces
Water......................	50 gallons		3 gallons

Dissolve the bluestone in a wooden or earthenware vessel, using hot water. Dilute with half the water. Slake the lime in a small quantity of water; then add the rest of the water. Pour the dilute bluestone and lime solutions together, straining them through a fine cheesecloth or brass-wire strainer, and mix thoroughly. The mixture should be made fresh each time it is used, as it does not keep well.

Since stone lime air-slakes rapidly and then is no longer good for Bordeaux mixture, and since it also is often difficult to get at short notice, it is best to make up a stock solution of lime containing 1 pound to each gallon of water. This will keep indefinitely if not allowed to dry out. A stock solution of bluestone can also be made by dissolving 1 pound of the copper sulfate crystals in a gallon of water. One quart of each of these stock solutions is equivalent to the 4 ounces of lime and bluestone given in the formula. The stock solutions may be stored in old glass jars or other containers until needed. Dilute each with half the required quantity of water before mixing. Where biting insects, such as potato beetles, are to be controlled, as well as diseases, add 2 ounces of powdered calcium arsenate to the 3-gallon formula for Bordeaux mixture given above. For a 2–4–50 mixture use 2 pounds of copper sulfate or 2 gallons of the stock solution for each 50 gallons.

Certain manufactured products, both pastes and powders, are available

---

* From U. S. D. A. Farmers' Bulletin No. 1684, with certain adaptations made by Professor Walter B. Balch.

for making up Bordeaux mixture and are especially convenient for use in small gardens and quite satisfactory under most conditions of moderate infection.

Organic Mercuries.—During the past few years several organic mercury compounds have been put on the market under a variety of trade names and have been used with more or less success for the disinfection of all sorts of seeds and soil in cold-frames to control various damping-off fungi or other disease-producing organisms that overwinter in the soil or in the seed. These disinfectants can usually be purchased from the handlers of farm supplies or at drug stores. They are available in both dust and liquid form and should be used in accordance with the directions on the containers.

Formaldehyde.—Formaldehyde (formalin) is also used for treating seed potatoes, onion seeds, and soil to prevent diseases. It is a clear solution of 37 per cent formaldehyde gas in water, which retails for about 35 cents a pint. It is very irritating to the eyes and to cuts and has a very drying effect on the skin, but is not poisonous. It does not attack metals. For most purposes use 1 teaspoonful to a pint, 1 ounce to 2 gallons, or 1 pint to 30 gallons, of water. To protect potatoes against scab, soak the seed potatoes for 2 hours in the above solution. To disinfect soil, drench it with a 1 to 200 solution at the rate of three-fourths of a gallon per square foot of area several days before the soil is to be used.

Dust Seed Treatments.—Two dust seed treatments for the prevention of damping-off have been found to give excellent results: (1) Monohydrate copper sulfate dust and (2) red oxide of copper dust. The monohydrate copper sulfate is applied to the seed at the rate of 1 heaping tablespoonful of dust to 0.5 pound of seed. The dust and seed are shaken together in a closed container until the seed is thoroughly coated with the dust. The red oxide of copper is applied in the same manner at the following rates: For tomato seed, 1 tablespoonful to 3.5 ounces of seed; for other small seeds, use 1 level teaspoonful of dust to 1 pound of seed.

Insecticides

Two classes of insecticides are used for controlling insects—stomach poisons and contact poisons.

Stomach poisons, such as calcium arsenate, cryolite, and paris green, are used for insects like the striped cucumber beetles, bean beetles, and potato beetles, which injure plants by chewing the leaves or stems.

Contact poisons, such as pyrethrum, soap, and nicotine sulfate, that kill by touching the insects, are necessary for sucking insects like plant lice and squash bugs. Stomach poisons are of no value for sucking insects.

Two level teaspoonfuls of paris green or 10 of calcium arsenate to each gallon of water or other spray mixture will suffice for the preparation of small quantities for the home garden. The addition of three or four times as much lime will make these arsenicals safer from the standpoint of plant injury for use on most vegetable plants by taking up any free arsenic which might otherwise injure the foliage. However, paris green or calcium arsenate should not be used on bean foliage.

If these arsenicals are used as dusts they should be thoroughly mixed with from 5 to 10 times their volume of hydrated lime or gypsum.

Nicotine Sulfate as a Spray.—For small gardens use a teaspoonful of nicotine sulfate in a gallon of water. An ounce of soap may be shaved up and thoroughly mixed with the solution. Full directions for mixing are given on the containers. By looking carefully at the freshly sprayed plants, one can tell whether there is enough soap in the mixture. If the spray draws together in drops, more soap should be added. When possible, fish-oil soap should be used, but cheap laundry soap will do. If the nicotine sulfate solution has stood for any length of time, it should be mixed thoroughly before being used. The insects themselves must be wet by the spray or they will not be killed.

Nicotine Sulfate as a Dust.—Nicotine sulfate combined with a dry carrier is also useful whenever it is preferable to use this form of application; it can be obtained commercially from several manufacturers. For home use it may be prepared by adding the required proportion of nicotine sulfate to hydrated lime.

For the treatment of small plantings, 1 or 2 pounds of nicotine dust may be prepared by using an ordinary household flour sifter, using 1 pound of hydrated lime and 1 ounce of nicotine sulfate. Be sure to resift at least three times to insure a thorough mixture. Larger quantities may be prepared by placing the lime and nicotine in a keg or metal drum for 4 or 5 minutes to secure thorough mixing. This mixture is a satisfactory dust for use against aphids and the striped cucumber beetle. For the latter, the ground around the plants, as well as the plants themselves, should be thoroughly whitened with the dust when the insects make their first appearance. A single application is usually successful, but the treatment may be repeated as often as required.

Nicotine dust must be preserved in tight metal or glass containers, as it loses its strength very rapidly when exposed to air.

To control the red spider and some other kinds of mites, sulfur may be either dusted on plants or mixed with water, a teaspoonful of sulfur to a quart of water, and sprayed.

Under some conditions, particularly during hot weather, sulfur may cause serious injury to the foliage of squashes, melons, and cucumbers, and to the fruits of the raspberry.

Soap Sprays.—Ordinary soapsuds is a good spray for plant lice and leafhoppers. It should be made by dissolving an ounce of laundry soap or a rounded tablespoonful of whale-oil or fish-oil soap in a quart of hot water. This also must reach the bodies of the insects in order to kill them. This spray must not be used full strength on very tender plants, such as young cabbage or cauliflower in seed beds, on garden peas, or on young beans, as it will injure the leaves. Use half strength on these plants.

A stock solution of soft soap may be more convenient for quick or frequent applications, and may be made either from bar soap or soap flakes. The white coconut-oil soaps are particularly good as insecticides and will work well in hard water.

Pyrethrum Powders and Extracts.—The insect powders sold as buhach,

Persian insect powder, and Dalmatian insect powder are composed of the finely pulverized flower heads of three species of *Chrysanthemum*. The active poison that they contain is a volatile oil that is much more poisonous to insects than to the higher animals. This oil forms the basis for a large number of commercial fly and household sprays and has recently been placed on the market as a contact insecticide for use against garden and greenhouse insects. It has the advantage of being practically nonpoisonous to human beings in the dilutions used against insects, and may safely be applied to such crops as greens, snap beans, cabbage, and celery. Either the pyrethrum powder itself or the extracts made from it may be used. They should be kept in tight containers while stored, as they lose strength rapidly by exposure to air. To be effective, they must actually touch the bodies of the insects against which they are used. Follow the directions of the manufacturers as to application, as the concentration of the commercial preparations varies greatly.

Derris and Other Rotenone Insecticides.—Derris and other insecticides containing rotenone are very effective in killing certain insects attacking vegetables, particularly the Mexican bean beetle, the cabbageworm, the melon worm, the pickleworm, and several species of flea beetles. From the evidence at hand, the compounds containing rotenone, when applied in the dosages recommended, should not leave harmful residues on the crop when harvested, and they may be applied safely to all vegetable crops without fear of injury to the plants. The active principles of these rotenone-containing compounds are rendered inert within a comparatively short time after they are applied to the plants through the action of sunlight and exposure to the air, especially when spread thinly over the plants.

The rotenone content in the commercially prepared dusts and sprays varies. The dusts are sold under various trade names and should be used according to the directions of the manufacturer.

Home-made Derris Dusts.—Very efficient home-made derris dusts may be prepared by mixing finely ground derris root with various diluents. The derris-root powder should be of such a degree of fineness that not less than 90 per cent of it will pass through a sieve having 200 meshes per linear inch, and all of the material (100 per cent) should pass through a sieve having 80 meshes to the linear inch. Satisfactory diluents for the derris-root powder are such non-alkaline materials as finely ground tobacco dust, finely ground clay, kaolin, talc, wheat flour, dusting gypsum, diatomaceous earth, infusorial earth, and sulfur. The same method of mixing as described for nicotine sulfate as a dust should be followed, except that lime should *not* be used for this purpose.

The rotenone content of the finished dust mixture depends on the quantity of diluent used and the rotenone content of the derris-root powder.

To prepare a dust containing 1 per cent rotenone, use the following formula:

Derris powder (4 per cent rotenone)	25 pounds (1 part by weight)
Diluent	75 pounds (3 parts by weight)

If the rotenone content of the derris powder is greater or less than 4 per cent, the proportions of the inert diluent must be varied accordingly. For ex-

QUANTITIES OF INSECTICIDES OR INGREDIENTS TO BE USED IN PREPARING SPRAYS

Derris-Root Powder[1]

Materials	With 1 Gallon of Water	With 3 Gallons of Water	With 50 Gallons of Water
5 per cent rotenone	1 ounce[2]	2 ounces	2 pounds
4 per cent rotenone	1 ounce	2½ ounces	2⅔ pounds
3 per cent rotenone	1½ ounces	3¼ ounces	3½ ounces
0.75 per cent rotenone	4½ ounces	13½ ounces	14 pounds
0.5 per cent rotenone	7 ounces	1¼ pounds	21 pounds

Cryolite

Cryolite	1 ounce[2]	3 ounces	3 pounds

Paris Green-Lime Mixture

Paris green	2 level teaspoonfuls	6 level teaspoonfuls	½ pound
Lime	2 level tablespoonfuls	2 ounces	2 pounds

Calcium Arsenate-Lime Mixture

Calcium arsenate	10 level teaspoonfuls	2 ounces	2 pounds
Lime	10 level tablespoonfuls	8 ounces	8 pounds

Nicotine Sulfate-Soap Mixture

Nicotine sulfate[3]	1 level teaspoonful	3 level teaspoonfuls	6 fluid ounces
Cake soap	1-inch cube	4 ounces	4 pounds
(Or soap flakes)	2 level tablespoonfuls	2 ounces	2 pounds

[1] These dilutions give a rotenone content of approximately 0.025 per cent in the completed spray.
[2] The table on page 450 gives dry-measure equivalent.
[3] A solution containing 40 per cent of nicotine by weight.

ample: 1 part of a derris powder containing 5 per cent of rotenone should be mixed with 4 parts of the diluent by weight—that is, 20 pounds of derris powder and 80 pounds of the diluent—to obtain a 1 per cent rotenone dust. Manufacturers of derris-root powders will usually supply ground root of a specified rotenone content upon request.

Home-made Derris Sprays.—In preparing derris sprays for the control of the Mexican bean beetle, cabbageworms, or similar insects, use 2 or 2½ per cent of the derris powder having a rotenone content of 4 per cent in 50 gallons of water (or at the rate of 2 or 2½ ounces in 3 gallons of water for smaller quantities). This gives the spray a rotenone content of approximately 0.02 or 0.025 per cent.

The preceding table gives the quantities of insecticides or ingredients that should be used with 1, 3, or 50 gallons of water in making up a spray.

The derris powder should be wet thoroughly in a small quantity of water before it is added to the bulk of the water in the spray tank. No sticker or spreader seems necessary. Under some conditions, however, it may be found necessary to add to the spray a nonalkaline spreader or sticker, such as high-grade liquid or powdered neutral coconut-oil soap, miscible pine oil, or one of the sulfonated oils.

Fluorine Insecticides.—There are a number of insecticides, such as sodium fluosilicate and cryolite, in which the poisonous principle is some compound of fluorine. These insecticides are especially useful in the control of the Mexican bean beetle, cabbageworms, and the flea beetle. As has been stated, these preparations should not be applied to the crop when the foliage or fruits that will be marketed or eaten are on the plant, unless the residue can be removed by washing or stripping.

Tables of Measures.—The following tables of measures will be found convenient for ascertaining the exact quantities of the various materials when used in small sprayers:

Liquid measure:
- 3 level teaspoonfuls = 1 level tablespoonful
- 2 level tablespoonfuls = 1 ounce
- 29 cubic centimeters = 1 ounce
- 16 ounces = 1 pint
- 8 pints = 1 gallon
- 2½ teaspoonfuls in 1 gallon = approximately 1–400 dilution
- 1½ teaspoonfuls in 1 gallon = approximately 1–800 dilution

Dry measure (approximately):
- 28.35 grams = 1 ounce
- 16 ounces = 1 pound
- 3 level teaspoonfuls = 1 level tablespoonful
- 4½ level tablespoonfuls of derris-root powder weigh 1 ounce
- 3 level tablespoonfuls of cryolite weigh 1 ounce
- 1½ level tablespoonfuls of paris green weigh 1 ounce
- 4½ level tablespoonfuls of calcium arsenate weigh 1 ounce

Quantity of Sprays or Dusts to Apply.—*Sprays*: For small gardens, approximately 2 quarts of liquid spray are required for 50 feet of row for each application. One acre of crops grown in rows (such as beans, potatoes, and cabbage) requires from 75 to 200 gallons of liquid spray per application, depending upon various factors, including the crop, the size of the plants, and the thickness of the stand. On an average, approximately 100 gallons of spray are required per acre.

Dusts: For small gardens, approximately 2 ounces of dust mixtures (see tables of measures on page 449) are required per 50 feet of row for each application. One acre requires from 15 to 25 pounds of dust per application, subject to the same variation mentioned for sprays. On an average, approximately 20 pounds of the dust mixture are applied per acre at each application.

How to Spray

To be successful in the control of diseases and insects, the spray mixtures must be properly made, and spraying must be done promptly and thoroughly. Do not wait until the plants have been seriously injured, but begin to spray as soon as the trouble is seen. Use good apparatus and spray carefully. Using a watering pot or whisk broom is not spraying and is a hit-or-miss method that covers the plants only partially. The ideal spray is a fine mist, and the best work is done when the entire plant is thoroughly and evenly covered with very fine drops. Stop spraying before the foliage is drenched. The higher the pressure the better the spray.

Spraying with Bordeaux mixture should be done before the rains rather than after, provided the spray has time to dry on the leaves. The intervals between spray applications depend on the weather and the rapidity of plant growth. If it is rainy or muggy and there are fogs or heavy dews, these conditions are favorable for diseases and for rapid growth. Spraying should be done more frequently to keep the foliage protected at all times.

Spraying and Dusting Tools

The sprays and dusts may be put on in many ways. For the small garden an atomizer sprayer is good, but a compressed-air sprayer is better for gardens of medium size.

When the treatment requires that the insecticide be applied to the under sides of the leaves, as for the Mexican bean beetle, an angle nozzle should be used.

The container for the liquid in the sprayers should be made of glass, brass, or galvanized steel, as Bordeaux mixture and other materials corrode tin and iron.

Shaking the dust from a fine cheesecloth bag or from a can with a handle and a perforated bottom is not recommended, as it results in an uneven and excessive application of material. Several small, cheap, but effective dust guns are on the market and should be used in preference to the cruder methods.

Miscellaneous Control Methods

Soil Disinfection.—Young plants grown in flats or boxes, to be set in the garden, are often troubled with damping-off, and young cabbage plants are likely to be attacked by clubroot. The organisms that cause these diseases live in the soil and will be carried on the diseased plants into the garden. The best way to get rid of these organisms is to treat the soil a few days before planting the seeds, either with boiling water or formaldehyde solution or with steam.

If the first method is used, set the flat or box of soil over the sink and pour

the boiling water into it as fast as the soil will take it up. Use 9 quarts of water for a box 1 foot square with soil 4 inches deep. When the soil has dried out enough, plant the seeds. In this treated soil seeds will sprout better and plants grow faster and stronger than in untreated soil.

For directions for using formaldehyde solution, see *Formaldehyde* (page 446).

The pressure cookers or steam sterilizers used for canning purposes are excellent for sterilizing small quantities of soil to kill insects and diseases, or the soil may be thoroughly baked in a pan in the oven.

Lime.—Lime is used in several forms in plant-disease control. Quicklime or stone lime in lump form is used for slaking to make Bordeaux mixture. When the lime becomes air-slaked from long standing it is of no value for this purpose. A good grade of hydrated lime is also suitable. About 25 per cent more by weight of hydrated lime than of quicklime is required.

To correct too great acidity in land it is best to apply air-slaked or hydrated lime. Ground limestone is also used. Its action is slower, and it may be applied in larger quantities without injuring the soil. For the control of cabbage clubroot apply hydrated lime at the rate of 25 pounds to the square rod. Do not apply lime to land to be planted in potatoes, since it will tend to increase scab injury.

Air-slaked lime will also keep away certain insects and is a good remedy for slugs.

Fumigation.—The materials most commonly used for the fumigation of weevil-infested peas, beans, or cowpeas, and similar seeds, are carbon disulfide or hydrocyanic acid gas or an ethylene oxide-carbon dioxide mixture.

Do not fumigate the seeds until they are thoroughly dry. Place the seeds to be fumigated in an airtight container, such as a tin pail, wash boiler, or watertight barrel, garbage can, barrel lined with heavy paper, or a specially constructed fumigation chamber or room. Fumigated seed should be thoroughly aired as soon as the fumigation period is over.

Carbon Disulfide.—Carbon disulfide is one of the most effective, the cheapest, and the simplest fumigant to be considered, wherever insurance or other regulations permit its use. The principal objection is that it is highly inflammable. Under average conditions of fumigation, 10 pounds (1 gallon) of the material should be used per 1,000 cubic feet, or for small containers it should be used at the rate of 1 fluid ounce (2 level tablespoonfuls) to each 10 cubic feet. In estimating the quantity of carbon disulfide needed, the number of cubic feet in the container should always be measured, and not solely the space occupied by the seed. It is better to use too much than too little of the carbon disulfide.

Pour the liquid carbon disulfide into pie tins or similar shallow dishes and place these on top of the seed to be fumigated, or the liquid may be poured or sprinkled directly upon the seed without danger of injury to germination or bad effects upon the food value. The gas from this fumigant is heavier than air and evaporates more quickly if a large surface of the liquid is exposed to the air.

Fumigation with carbon disulfide must be continued from 24 to 48 hours at or above a temperature of 75° F. It is not effective at temperatures below 65° F.

Caution.—Although carbon disulfide is a standard fumigant and has been used safely for many years with the observance of proper safeguards, *it must be remembered that the gas is explosive and inflammable if exposed to fire. Lighted matches, cigars, pipes, or lanterns, or sparks from electric fixtures, or even very hot steam pipes or radiators will cause it to explode.*

Hydrocyanic Acid Gas.—Fumigation with hydrocyanic acid gas is recommended when large quantities of peas, beans, or similar seed are found infested by weevils in warehouses, seed houses, freight cars, and similar situations. For best results the seeds should be in sacks and so stacked that the gas can reach a large portion of the outside of each sack. Under these circumstances fumigation with the gas has been found very effective in killing weevils. *Hydrocyanic acid gas is extremely poisonous; in fact, it is poisonous to human beings if breathed even in small quantities. Consequently, it should be used as a fumigant only by skilled, responsible persons who are thoroughly informed upon the subject of fumigation.*

The advantages of this fumigant are that it is noninflammable and nonexplosive when mixed with air in the proportions used in fumigation, and it does not injure the germination or food value of the seed. As hydrocyanic acid gas acts more quickly than any other known fumigant, it often proves effective in warehouses, freight cars, etc., that are not entirely airtight, because the gas performs its killing action before escaping through cracks or other openings. Under these or similar circumstances particular precautions should be observed to keep people and domestic animals from coming in contact with the escaping gas.

For general fumigation work, one-half pound of liquid hydrocyanic acid or 1 pound of granular sodium cyanide should be used for each 1,000 cubic feet of space. For large warehouses or similar structures well filled with peas or other seeds the dosage should be increased to 20 ounces of liquid hydrocyanic acid, or 2½ pounds of granulated sodium cyanide, per 1,000 cubic feet.

There are several methods of generating hydrocyanic acid gas for fumigation purposes. For further information on this subject write to the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, or to your county agricultural agent, State agricultural experiment station, or State department of agriculture.

Ethylene Oxide-Carbon Dioxide Mixture.—The ethylene oxide-carbon dioxide mixture is composed of one part of ethylene oxide and nine parts of carbon dioxide by weight. It is a noninflammable, nonexplosive gas and is not highly toxic to man. For these reasons this fumigant may often be used where insurance regulations or other restrictions prevent the use of other fumigants. The gas is sold in cylinders under pressure and is adapted chiefly for use in fumigating chambers. Moreover, it has the advantage of not leaving any appreciable odor in the fumigated product.

The ethylene oxide-carbon dioxide mixture should be used at the rate of 20 pounds per 1,000 cubic feet under average conditions, with suitable changes in this dosage according to the airtightness of the fumigating chamber. The length of fumigation should be the same as for carbon disulfide, and the room should be at a temperature not lower than 60° F.

The cost of this fumigant ranges from approximately 15 to 20 cents a pound, delivered.

Caution.—The ethylene oxide-carbon dioxide mixture should not be used to fumigate seeds intended for planting purposes, since this gas ordinarily injures the germination of such seed.

Heat Treatment

Most of the common species of weevils in peas, beans, cowpeas, and similar seed can be killed by heat. Such seed should be thoroughly dried before treatment. Small quantities can be treated by placing the seed in an oven, after they have been spread thinly in shallow pans, and heating them to a temperature between 130° and 140° F. for 30 minutes. If the seeds are intended for planting, the temperature should not exceed 135°. Small quantities of weevil-infested seeds can be treated by dipping them into boiling water for 1 minute. If this treatment is continued for more than 1 minute, however, the seeds may be injured for planting purposes. Dry the seeds immediately after removal from the water by spreading them out thinly in a well-ventilated place.

Weevil development in large quantities of beans, peas, cowpeas, and similar seeds can be stopped by a process known as kiln-drying. For further information on this subject write to the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, or to your county agricultural agent, State department of agriculture, or State agricultural experiment station.

Grasshoppers

The best method of control is to use poisoned bran mash prepared in the following manner:

Formula for a small amount:		
Wheat bran	1	pound
Paris green or white arsenic	1	ounce
Blackstrap molasses or corn syrup	3	ounces
Lemon or orange (including peel)	½	
Water	1¼	pints
Formula for a large amount:		
Wheat bran	20	pounds
Paris green or white arsenic (Com. grade)	1	pound
Blackstrap molasses or corn syrup	½	gallon
Lemons or oranges (including peel)	3	
Water	3¼	gallons

In preparing the bran mash, mix the bran and the white arsenic or paris green thoroughly in a pan or washtub while dry. Squeeze the juice of the lemons or oranges into the water, chop the remaining pulp and peel to fine bits, or run them through a meat grinder, and add them to the water. Dissolve the molasses in the water and wet the bran and poison with the mixture, stirring at the same time so as to dampen the mash thoroughly.

The grasshoppers should be poisoned before they enter the gardens or yards to attack the flowers and shrubs. This can be done by keeping a close watch,

and as soon as the hoppers are beginning to move into the yard, a strip of the bran mash should be sown broadcast along the edge of the garden nearest the source of infestation. The mash should be sown early in the morning, or about the time the grasshoppers begin to move about or resume activity. In order to protect the flowers and shrubs, it may be necessary to make an application of the bait each day for three or four days. If the hoppers have already attacked the plants, the poisoned bait should be scattered sparingly over the flowers and shrubs and beneath them. The shrubs may also be protected by spraying with arsenate of lead at the rate of two pounds to 50 gallons of water.

Caution.—Receptacles containing the bait should not be left around where children, dogs, chickens, and livestock will have access to it. With proper care there is no danger.

Cutworms

The most effective and most practical method of destroying cutworms is to poison them with poisoned bran mash, prepared in the same manner as for grasshoppers.

As soon as the cutworms appear, sow or scatter thinly the poisoned bran mash along the rows or about the bases of the plants to be protected. In case the plants are growing in beds, the bran mash should be sown broadcast over the plants. The application should be made well toward evening or at dusk, since cutworms feed only at night or on dull, cloudy days. Do not scatter the bait on a windy, chilly evening. Other worms may appear by coming in from adjoining grasslands. If such is the case, repeat the application.

A PARTIAL LIST OF GOOD BOOKS ON HORTICULTURE

Name of Book	Author	Publisher	List Price
Fruit Production			
Principles of Fruit Growing...	L. H. Bailey	The Macmillan Co.	$ 2.50
Fruit Growing..............	W. H. Chandler	Houghton Mifflin Co.	5.00
Fundamentals of Fruit Growing	Gardner, Bradford, and Hooker	McGraw-Hill Book Co.	4.50
Productive Orcharding.......	F. C. Sears	J. B. Lippincott Co.	3.00
Productive Small Fruit Culture	F. C. Sears	J. B. Lippincott Co.	3.00
Commercial Apple Industry...	Folger and Thomson	The Macmillan Co.	3.25
Strawberry Culture..........	S. W. Fletcher	The Macmillan Co.	2.00
Peach Growing..............	H. P. Gould	The Macmillan Co.	2.25
Manual of American Grape Growing	U. P. Hedrick	The Macmillan Co.	2.50
The Pruning Manual........	L. H. Bailey	The Macmillan Co.	2.50
Diseases of Illinois Fruits.....	H. W. Anderson	Illinois Agricultural Experiment Station	.40
Insects of Farm, Garden and Orchard	Sanderson and Pears	John Wiley & Sons, Inc.	3.50
Systematic Pomology			
Apples of New York.........	S. A. Beach	N. Y. Dept. of Agriculture, Albany, N. Y.	2.25
Systematic Pomology........	U. P. Hedrick	The Macmillan Co.	4.00
Cyclopedia of Hardy Fruits...	U. P. Hedrick	The Macmillan Co.	6.00
Essentials of Systematic Pomology	Brooks D. Drain	John Wiley & Sons, Inc.	2.75
Vegetable Production			
Vegetable Crops............	H. C. Thompson	McGraw-Hill Book Co.	4.50
Garden Farming............	L. C. Corbett	Ginn and Co.	3.20
The Vegetable Garden.......	R. L. Watts	Orange Judd Co.	1.75
The Potato................	William Stuart	J. B. Lippincott Co.	3.00
The Potato................	A. W. Gilbert	The Macmillan Co.	2.00
Ornamental Gardening and Forestry			
Landscape Design...........	Hubbard and Kimball	The Macmillan Co.	6.00
Book of Landscape Gardening.	F. A. Waugh	Orange Judd Co.	2.00
Farm Forestry..............	J. A. Ferguson	John Wiley & Sons, Inc.	1.50
Commercial Floriculture......	Fritz Bahr	A. T. De La Mare Printing and Publishing Co.	5.00
General Works			
Standard Cyclopedia of Horticulture	L. H. Bailey	The Macmillan Co.	40.00
The Nursery Manual........	L. H. Bailey	The Macmillan Co.	2.50
The Farm and Garden Rule Book	L. H. Bailey	The Macmillan Co.	2.50
Principles of Plant Growth...	E. S. Goff	The Macmillan Co.	2.10
Plant Breeding..............	Bailey and Gilbert	The Macmillan Co.	2.90
Yearbook, 1937.............		U. S. D. A.	1.00

INDEX

A

Accounts, keeping, 106–107
Acidity of soil, 326
Acknowledgments, vii
Acme harrow, 126
Acreage, bean, corn, melon, okra, 277
Activities (*see* each job)
Aims (*see* each job)
Air drainage,
  peach, 122
  strawberry, 162
Air for plants, 2
American plums, 121–122
Analyses,
  apple, 27
  asparagus, 309
  beets, 301
    other roots, 301
  bush-fruit, 208
  cabbage, 343
  cauliflower, 343
  celery, 323
  grape, 181
  improvement, 405
  lettuce, 333
  melon, corn, bean, and okra, 269
  mustard and spinach, 355
  onion, 293
  peach, plum, and cherry, 109
  pear, 27
  peas, 361
  rhubarb, 315
  strawberry, 155
  tomato, eggplant, and pepper, 239
  woodland, 371
Annual flower planting, 419–421
Anthracnose,
  bean, 287
  bush-fruit, 228
  grape, 199
  melon, 287
Aphis and aphids,
  apple, 72
  bush-fruit, 226–227
  elms, 391
  peach, plum, and cherry, 144
  peas, 367
  turnip, 305
  vegetable, 261
  woodland, 391
  woolly, 72
Apple and pear, 27–107
  analysis, 27
  boxes, 102–103
  budding, 31, 95–96
  bulletins, 27
  butter, 106
  buying trees, 42–43
  capital, 28
  containers, 99
  culling, 100–101
  cultivation, 50–51
  diseases,
    bitter rot, 37, 62
    blotch, 37, 64
    canker, 37, 62
    control of, 60
    fire blight, 37, 61
    frog eye, 64
    phoma, 64
    rust, 37, 62–63
    scab, 37, 60, 79
    sun scald, 62
  drainage, 40
  enemies,
    aphis, 61, 72
    blister mites, 72
    borers, 65, 67
    canker worm, 66–67, 80
    codling moth, 62, 66
    curculio, 62, 70
    danger of, 27
    maggot, 65
    scale, San José, 70–72
    tent caterpillar, 68–69
  enterprise, 28–106
  fertilization, 51–54
  fruit,
    thinning of, 59
    using, 104–105
    varieties of, 35–36, 104–105
      resistant, 37
  grades, 99
  grading, 99–103
    table, 102
  grafting, 30–34
    propagation by, 31–32
  growth, 62
  harvesting, 97
  intercrops, 48–49
  jelly, 106
  jobs,
    list of, 27

Apple and pear—(*Continued*)
  labor, 28
  locations, 39–40
  marketing, 104–106
  markets, 28
  marking, 99
  maturity, judging, 97
  orchards,
    cultivation of, 50–54
    exposure of, 39
    location of, 39
    renovating old, 92
      budding, 95–96
      cleft-grafting, 93–95
      replanting, 96
      steps in, 93
      top-working, 94–95
    varieties, home, 36
  packing, 99–103
    guide for, 103
  planting, 44–48
  possibilities, 27
  pruning, 47, 54–59
  quality, 38
  references, 27
  region maps, 29
  regions, 28–29
  renovation of, 92–96
  seasons, 38
  sites, 39–40
    laying out, 44–46
  soils, 39–40
  spraying, 46, 66, 84–91
    purpose of, 74
    schedule, 87
  sprays,
    compared, 73
    kinds of, 74–83
  storage, 98–99
  storehouses, 98–99
  trees,
    age of, 42
    buying, 42
    holes for setting, 46
    nurseries, 42
    planting,
      plan of, 45
      pruning before, 47
Aquarium,
  balanced, 6
Arsenate,
  lead, 79–80
  lime, 80
  white, 79
Arsenical poisons, 466
Arsenite, zinc, 81
Artichoke,
  globe, 320
  Jerusalem, 321
Asparagus,
  analysis, 309
  bulletins, 309
  canning, 313
  capital, 309
  cultivating, 312
  cutting, 312–313
  crowns, 311
    protection of, 312
  enemies, 312
  enterprise, 309–312
    beetle, 312
    rust, 309–310, 312
  harvesting, 312–313
  jobs, 309
  labor, 309
  market demand, 309
  marketing, 313
  plants, 310
  possibilities, 309
  references, 309
  regions, 309
  seed, 310
  soils, 310
    fertilizing, 310–311
    preparation of, 311
  tops, 312

B

Bare fallow, 240
Barrel sprayers, 85
Baskets,
  grape, 203–204
  peach, plum, cherry, 148–152
Beans,
  analysis of, 269
  bulletins, 269
  capital, 270
  cultivating, 282–284
  enterprise, 269–292
  fertilizers, 280
  fly, white, 287
  jobs, list of, 269
  labor, 270
  markets, 271
  planting, 280–282
  possibilities, 269
  seed, 277–280
  soils,
    acreage, 277
    drouthy, 276–277
    for early crops, 276

Beans, soils—(*Continued*)
rotation, 277
warm, 281
types of, 274
varieties of, 274–275
weevils, 287
yield, 270–271
Bees aid pollination, 9
Beets and other roots, 301–308
analysis, 301
bulletins, 301
climate, 301
cultivation, 304
enemies, 305–307
fertilizing, 303
jobs, 301
marketing, 307
markets, 301
nematodes, 306
planting, 304
possibilities, 301
references, 301
scab disease, 306
seed, 302
soils, 303
preparation of, 303
varieties, 302
Bird life,
enemies of, 391
protection of, 391
Bitter rot, 62
resistance to, 37
Blackberries, 207
analysis, 207
bulletins, 207
enemies, control of, 224–230
habits, 219–220
harvesting, 230–231
jobs, 207
marketing, 232
prices, 208
propagation of, 213–215
pruning, 219–220
references, 207
region map, 209
regions, 208
soils, 208
adaptations, 210–211
trellising, 223
varieties, 211
yield, 208
Black-leg, cabbage, cauliflower, 349
Black rot,
cabbage, cauliflower, 350
treatment of, 349
forest tree, 389
grape, 197
Blanching,
board, 328–330
ethylene gas, 330
paper, 329, 330
cauliflower, 348
celery, 328–330
lettuce, 339
methods of, 328
banking, 330
Blight,
chestnut, 389
resistance to, 37
tomato, 262
control of, 262
treatment of, 54, 61
twig, 61
Blister,
beetles, 261
mites, 72
rust, on white pine, 230
Blossoms, underground, 10–11
Blotch diseases, 64
resistance to, 37
Bordeaux, formula, 75, 445
mixing, 75–77
mixture, 75
Border, annual flower, 419–420
Borecole, 360
Borers, apple, 65–69
cane, 224
corn, 286
crown, 224
currant, 226
leaf, 261
peach, 142–143
stem, 261
vine, 286
Box packing, apple, 102–103
dewberry, 211, 231
raspberry, 231
strawberry, 177–178
Breeding plants, 17–23
Brown rot disease, 138, 139
Brussels sprouts, *see* cabbage, 343–354
Budding and grafting, 30
Budding apples, 31
materials, 116
old trees, 95, 96
peach, plum, cherry, 115–118
shield, 116, 117
types, 117
Buds, formation, 6–7, 24
kinds, 7
Bulbs, propagation, 437–439
Bulletins, apple and pear, 27
asparagus, 309
beets, other roots, 301

Bulletins—(*Continued*)
bush-fruits, 207
cabbage, cauliflower, 343
celery, 323
grape, 181
improvement, 405
lettuce, 333
melon, corn, bean, okra, 269
mustard, spinach, 355
onion, 293
peach, plum, cherry, 109
peas, 361
strawberry, 155
tomato, eggplant, pepper, 239
woodland, 371
Bunching, beets, other roots, 307
Bush-fruits, 207–232
adaptations, 210–211
analysis, 207
bulletins, 207
capital, 208
climate, 210–211
containers, 231
cultivation, 217, 218
enemies, 224–230
fruit bearing, 219
harvesting, 230–231
intercrops, 219
jobs, 207
kinds, 208–213
labor, 208
locations, 216–217
marketing, 232
maturity, 230
packing, 231
picking, 230–231
planting, 217, 219
possibilities, 207
prices, 208
propagation, 213–216
pruning, 219–223
pruning when setting, 218
references, 207
region maps, 209
regions, 208
repacking, 231
soil preparation, 216–217
soils, 208
uses, 232
varieties, 208–213
yields, 208
Buying, containers, 151
forest trees, 384
orchard trees, 123, 124
ornamentals, 432–434
road materials, 434
Buying—(*Continued*)
strawberry plants, 159–161
walk materials, 434

C

Cabbage and cauliflower, 343–354
analysis, 343
beds and plants, 345
bulletins, 343
capital, 343
cultivation, 348
enemies, 348–350
fertilizing, 346, 347
field and soil, 346
hardening, 346
harvesting, 351
jobs, 343
liming, 347
marketing, 352–354
markets, 344
maturity, 351
packing, 352
possibilities, 343
quality, 351–353
references, 343
regions, 343
seed, 345
soil preparation, 347
storage, 352, 353, 354
transplanting, 347
trimming, 351
varieties, 344, 345
watering, 347
wilt resistant, 350
Cabbage, checking growth, 348
frames, 253
worms, 348
Cane borers, 224
Cane tying, grape, 192
Canker, apple, 62
worms, 67, 80
Cannery, growing for, 266
peas, 368, 369
Canning asparagus, 313
Cantaloupe, early, 282
see melon, 269–292
varieties, 272, 273
Capital, apple and pear, 28
asparagus, 309
bush-fruit, 208
cabbage, cauliflower, 343
celery, 324
grape, 182
melon, corn, bean, okra, 270
onion, 294
orchard, 112–113

Capital—(*Continued*)
rhubarb, 315
strawberry, 156
tomato, eggplant, pepper, 241
Carbon dioxide, 2
Carrot, *see* beet, 301–307
varieties, 302, 303
worms, 306
Catalogs, nursery, 433
Catalpa seedlings, 382
Cauliflower, analysis, 343
blanching, 348
bulletins, 343
frames, 253
see cabbage, 343–354
Cedar rust, 63
Celery, 323–332
acidity of soil, 326
analysis, 323
blanching, 328–330
blight, 327
bulletins, 323
capital, 324
coöperation, 332
cultivation, 327
dugouts, 331
enemies, 324, 327–328
fertilizing, 326
field, 326
grading, 330
harvesting, 330
houses, 331
insects and diseases, 324
irrigation, 327
jobs, 323
labor, 324
marketing, 332
markets, 323
packing, 331
pithy stalks, 328
pits, 331
plant beds, 325
plant food, 326
plant hardening, 325
planting, 327
possibilities, 323
prices, 324
references, 323
ridging, 327, 329
running to seed, 328
seed, 324–325
selling, 332
soil preparation, 327
soils, 326
storing, 331
trenches, 331
Celery—(*Continued*)
varieties, 324
yields, 324
Certificate, inspection, 35
Certified vegetable seed, 278
Characteristics, impressing, 19
Chard, Swiss, 357–358
Chart, fertilizer mixing, 54
tomato diseases, 262
tomato insects, 262
Checking cabbage growth, 348
Cherry, baskets, 148
enterprise, 109–154
orchard, pruned, 135
see also peach, 109–153
stocks, 118
sweet and sour, 118–120
varieties of, 120–121
Chestnut blight, 389
Chip-budding, 117
Chives, *see* onion, 293–300
Chlorophyll exercise, 23
Cider, apple, 105
City garden, 235
Clean vs. sod culture, 50
Cleaning seed, 25
Cleft grafting, renovation, 93–95
Cleistogamous flowers, 10–11
Clematis, panicles, 416
Climate, beets, other roots, 301
onion, 293
rhubarb, 315
Clubroot, cabbage, 348
Codling moth, 66–67
Cold-frames, 247–253
cabbage, 253
Cold storage, apple and pear, 98
celery, 332
peach, plum, cherry, 152
Colors, flower buying, 432–434
Commercial, lime-sulfur, 77
strawberries, 158–159
vegetable seeds, 246
Commission selling, 265
Companion cropping, 304, 334
Concrete roads, 434
walks, 440
Conditions, *see* each job
Contact insecticides, 81
Containers, bush-fruit, 231
buying, 151
grape, 202–204
melon, corn, bean, okra, 289
peach, plum, cherry, 148–152
tomato, eggplant, peppers, 264
Contest, seed saving, 24
Contests, improvement, 443

Coöperative, association, 265–266
  manager, 266
  marketing,
    apple and pear, 105
    celery, 332
    dangers of, 266
    functions of, 265–266
    grape, 204–205
    strawberry, 180
    tomato, eggplant, pepper, 265–266
    vs. outsiders, 180
  shipping, 152
Cordwood, 403
Corn, 269–292
  analysis, 269
  bulletins, 269
  capital, 270
  cultivating, 282–283
  enemies, 284–287
  labor, 270
  markets, 271
  regions, 270
  salad, 360
  seeds, 277–282
  suckering, 283
  varieties, 271–273
  vegetable table, 237
  yields, 270
Cos lettuce, 335
Costs, peach orchard, 112–113
  woodland, 374
Cover crop, orchard, 132
  vineyard, 191–192
Cress, garden, 359
  upland, 359
Crew planting, 128
Cross-pollination, 10
Crown borers, 224
  gall, 141
Cucumber, 269–292
  beetles, 284
  irrigation, 274
  pollination, 283
  varieties, 273
Culling factors, apple, 101
Culls, apple and pear, 100–101
  apple and pear, 100–101
    preventing, 100–101
  use of fruits, 105
Cultivation, apple and pear, 50–51
  asparagus, 312
  beets, other roots, 304
  bush-fruit, 217–219
  cabbage, cauliflower, 348
  celery, 327
  lettuce, 338–339
Cultivation—(*Continued*)
  melon, corn, bean, okra, 283
  mustard, spinach, 356
  onion, 297–298
  peach, plum, cherry, 128–131
  peas, 366
  rhubarb, 317
  strawberry, 169–172
  tomato, eggplant, pepper, 257–260
  vineyard, 190–192
Curculio, apple and pear, 70
  plum, 141
  spraying, 138
Curing, onion, 299
Curl, peach leaf, 138–139
Currant, borers, 226
  cherry, 212
  exposure, 217
  jelly, 232
  maggots, 227
  propagation, 215–216
  pruning, 223
  see bush fruits, 207–223
  varieties, 212
  worms, 225
Cutaway-disk harrow, 129
Cut-over lands, 395
Cutting, asparagus, 312–313
  felled trees, 399
  greens, 357
Cuttings, currant, 215–216
  forest tree, 383
  making grape, 186–187
  planting grape, 187
Cutworms, 261
  climbing, 201

D

Debates, seed breeding, 25
Dewberry, Lucretia, 211
  propagation, 213
  see bush-fruits, 207–232
Diseases,
  apple and pear, 60–64
  apples, resistant, 37
    sprays for, 73–84
  celery, 327–328
  grape, 196–199
  melon, 287
  peach, plum, cherry, 138–141
  strawberry, 175
  tomato, eggplant, pepper, 262
  woodland, 389–391
Disk harrow, orchard, 51
Disking orchard soil, 41
Domestica plums, 122

Double cropping, 304
Downy mildew, grape, 199
Drainage, air, 122
  apple and pear, 40
  orchard soil, 123
Drawings, interpreting, 432
Drives, planning, 406–407, 411, 432
Drouth, injury to trees, 394
  strawberry, 163
Dry-mix sulfur lime, 78
Dusting, garden, 284–287
  insects, 89
  materials, 446–448, 450–451

E

Eggplant, Black Beauty, 243
  see tomato, 239–268
  soils, 245
  varieties, 244
Elevation, orchard, 122
Emulsions, oil, 81–82
Endive, 360
Enemies,
  apple and pear, 28
  asparagus, 312
  beets, other roots, 305–306
  bush-fruit, 224–230
  cabbage, cauliflower, 348–350
  celery, 324, 327–328
  grape, 195–202
  lettuce, 340
  melon, corn, bean, okra, 284–287
  peas, 367–368
  plant, 3
  strawberry, 174–175
  tomato, eggplant, pepper, 241, 260–262
  woodland, 389–391
Enterprises,
  apple and pear, 27–107
  asparagus, 309–313
  beets, other roots, 301–308
  bush-fruit, 207–232
  cabbage, cauliflower, 343–354
  celery, 323–332
  grape, 181–206
  improvement, 405–443
  landscape, 405–443
  lettuce, 333–342
  melon, corn, bean, okra, 269–292
  mustard, spinach, 355–360
  onion, 293–300
  peach, plum, cherry, 109–154
  peas, 361–370
  rhubarb, 315–318
  strawberry, 155–180
Enterprises—(*Continued*)
  tomato, eggplant, pepper, 239–268
  woodland, 371–403
Environment, effects, 19
Ethylene gas, blanching, 330
European corn borer, 286–287
Exercises, laboratory, 23–25
Expense records, 106
Exposure,
  apple and pear, 39–40
  bush-fruit, 217
  cherry, 113
  grape, 188
  peach and plum, 113
  strawberry, 162

F

Fall plowing, 240
Fancy apples, 99–100
Farm woodlot, *see* woodland, 371–403
Farmer's garden, 235–236
Farms, account, 106–107
Fertilizer, collection, 24
  home-mixing, 54
Fertilizing,
  apple and pear, 51–54
  asparagus, 310–311
  beets, other roots, 303
  cabbage, cauliflower, 346, 347
  celery, 326
  effects on trees, 131
  grapes, 192
  lettuce, 337
  mustard, spinach, 356
  onions, 296–297
  orchard effects, 53
  peach, plum, cherry, 132–133
  peas, 364
  strawberry, 170, 172
  tomato, eggplant, pepper, 257
  vegetables, 280
Field exercises, 23–25
Finding markets, 104
Fillers, orchard, 44
Fire blight, 61
Flat, cabbage, 346
Flea-beetle, grape, 201
Flowers, annual, 419–421
  cleistogamous, 10–11
  perennial, 417–418
  summer and fall, 418–420
  types of, 8
Flute-budding, 117
Food supply, plant, 2
Forcing cantaloupes, 282

Forest, cuttings, 383
  fires, 391–394
    injury by, 392
    laws, 393
    prevention of, 393
    starting, 392
    underground, 392
  nursery, 382–383
  planting, 386–389
  see woodland, 371–403
  seed beds, 382
  tree buying, 383–384
Formaldehyde, formula, 446
Formulas, insecticide, 445–455
Foundation, planting, 408, 412, 413
Frames, 247–254
Freshness, vegetable, 291
Frog-eye disease, 64
Frost conditions, 146
  dangers, 146
  foretelling, 147
  protection, 145–147
Fruit, crop, waiting, 49
  juices, 232
  spot, phoma, 64
  spurs, apple, 57
Fuel, woodland, 402
Fungicides, 445–446
  using, 78
Fungus, damping-off, 340
Fusarium wilt, 262

G

Gall,
  nursery, 141
  raspberry, 227, 228
  root, 141
Garden,
  city, 235
  cress, 359
  farmers, 235–236
  home, 233–237
  implements, 255
  marker, 281
  plans for, 234–236
  planting table, 236–237
  seeds, sources, 13
  tools, 305, 361
Garlic, *see* onion, 293–300
Garnish, 359
Gas sprayers, 88
Georgia carrier, baskets, 152
Germination, conditions, 3–4
  exercise, 23–25
Globe artichoke, 320–321
Gooseberry,
  exposure, 217
  propagation, 216
  pruning, 223
  see bush-fruits, 207–232
  varieties, 212–213
Grading,
  apple and pear, 99–103
  celery, 330
  lettuce, 341
  mechanical, 150
  melon, corn, bean, okra, 288–289
  onion, 300
  peach, plum, cherry, 147–151
  tomato, eggplant, pepper, 264
Grafting and budding, 30
Grafting, grapes, 187
  stocks, 30
  terms defined, 30–31
  tongue, 31
  top working, 31
  types, 33–34
  wax, 34
Grafts, setting, 32
Grape, 181–206
  analysis, 181
  anthracnose, 200
  berry moth, 201
  black rot, 197
  bulletins, 181
  bunch type, 183
  cane tying, 192
  capital, 182
  climbing cutworms, 201
  colors, 184
  congestion, 205
  containers, 203, 204
  cover crop, 191–192
  covering baskets, 205
  cultivation, annual, grapes, 190–192
    systems of,
      Kniffin, 194–195
      Munson, 193
      overhead, 195
      pruning, 192–194
      trellising, 192–194
      upright, 193
  cuttings, 186–187
  disease resistance, 184
  distances, 189
  downy mildew, 199
  enemies, 195–202
  exposure, 188
  fertilizing, 192
  flea-beetle, 201
  fruit bearing, 193
  grading, 202

Grape—(*Continued*)
  grafting, 187
  harvesting, 202–204
  heeling-in, 186
  high-renewal system, 194
  holes, 190
  intercrops, 191
  jobs, 181
  judging ripeness, 202
  juice, 205
  Kniffin system, 194–195
  knowledge, 182
  labor, 182
  layering, 187
  leaf-holder, 200
  leaf-hopper, 200
  location, 188
  marketing,
    coöperative, 204–205
      buying, 206
    difficulties in, 205
  Munson system, 193
  nematodes, 188
  nursery care, 187
  outlet, 182
  overhead system, 195
  packing, 202–204
  packing shed, 204
  phylloxera, 202
  plant food, 188–189
    handling, 190
  planting, 189–190
    season, 189
  possibilities, 181
  powdery mildew, 200
  propagation, 184–187
    vs. buying, 185
  pruning, 192–195
  references, 181
  regions, 182
  root worm, 201
  rose chafers, 201
  setting, 190
  single cordon, 194
  soil, 182, 188–189
    improvement, 189
    preparation, 188–189
  spray schedule, 202
  trellising, 192–195
  types, 183–184
  varieties, 182–184
Green manure, orchard, 132
  strawberry, 163
Greens, *see* mustard, 355–360
Growth, conditions, 1–2

H

Hand, garden tools, 305
Hardening, cabbage plants, 346
  celery plants, 325
Hardwood, mixed, 373
Harrowing, orchard soil, 41, 126
  tomato, eggplant, pepper, 255
Harvesting,
  apples and pears, 96–97
  asparagus, 312
  bush-fruit, 229–230
  cabbage, cauliflower, 351
  celery, 330
  lettuce, 340
  melon, corn, bean, okra, 288–289
  mustard, spinach, 357
  onion, 299
  orchard, equipment, 97
  peach, plum, cherry, 147–150
  peas, 368
    machines, 368
  rhubarb, 317
  strawberry, 177–178
  tomato, eggplant, pepper, 263–264
  trees, annual, 399
  trees in rotation, 399
  woodland, 397–400
Heading apple trees, 47–48
Head lettuce, 335
  see lettuce, 333–342
Heaters, orchard, 147
Hedges, kinds, 421–425
Heeling-in, grapes, 186
  plants, 434
  trees, 43, 124
Hellebore spray, 81
Hemlock cones, 376
Heredity, plant, 18
Hickory, enemies, 391
High vs. low heading, 47–48
Hillside, terracing, 126
Holes, apple and pear, 46
Holyoke market, 233
Home-made emulsion, 81–82
Home vegetable gardens, 233–238
Horn worm, tomato, 260
Horseradish, 319–320
Horticulture, books on, 457
Hotbed, celery, 325
  flats, 250
  frames, 248–252
  glass, 248
  heating, 250
  lettuce, 336
  locations, 249
  manure, 249

Hotbed—(*Continued*)
purposes, 248
shifting plants, 257
tomato, eggplant, pepper, 248–252
tools, 251
use, 250–253
vegetable dates, 254
ventilation, 251
watering, 251
Houses, storage, 98
Hybrids defined, 20
Hydrometer, lime-sulfur, 78

I

Implements, garden, 255, 258
Improvement,
analysis, 405
benefits, 441
bulletins, 405
contests, 443
enterprise, 405–443
jobs, 405
planning, 407–414
possibilities, 405–407
profits, 407, 442
project, 406, 407
publicity, 441–442
references, 405
Inlaying, 34
Inoculating peas, 363
Insecticides, 80–83
formulas, 446–455
Insects, apple and pear, 64–72
biting, 65–69
bush-fruit, 224–227
celery, 324, 327
dusting, 83–84, 89
grape, 200–202
in seeds, 12
kinds of, 65–69
melon, corn, bean, okra, 284–287
methods of fighting, 79–91
peach, plum, cherry, 141–144
pollination by, 10, 24
spraying, 84–92
sucking, 70–72
tomato, eggplant, pepper, 261
woodland, 391
Inspection, nursery trees, 35, 43, 124
Intercropping,
bush-fruit, 219
orchard, 48–49, 128–131
reasons for, 49
vineyard, 189
Intervals, peach, plum, cherry, 127
Introduction, plant life, 1–26

Irrigation, celery, 327
garden, 274

J

Japanese beetles, 144
Jerusalem artichoke, 321
Job analysis, benefits, vi
defined, v
plan, v
problems, v–vi
Jobs,
apple and pear, 27
asparagus, 309
beets, other roots, 301
bush-fruit, 207
cabbage, cauliflower, 343
celery, 323
grape, 181
improvement, 405
lettuce, 333
melon, corn, bean, okra, 269
mustard, spinach, 355
onion, 293
peach, plum, cherry, 109
peas, 361
rhubarb, 315
strawberry, 155
tomato, eggplant, pepper, 239
woodland, 371
Judging maturity, apples, 97
June vs. August buds, 123

K

Kale, 360
sea, 320
Kerosene emulsions, 81
Kniffin system, grapes, 194–195

L

Labeling fruit packages, 99, 103
Labor,
apple and pear, 28
asparagus, 309
bush-fruit, 209
cabbage, cauliflower, 343–344
grape, 182
lettuce, 333–334
melon, corn, bean, okra, 270
onion, 294
peas, 362
record form, 106
rhubarb, 315
strawberry, 156–157
tomato, eggplant, pepper, 241

Laboratory exercises, 23–25
Landscape effects, 412
  see improvement, 405–443
Larch woods, 378
Layering, grapes, 185
Laying out grounds, 430–432
  orchards, 44–46
Leaf-folder, grape, 200
Leaf-hopper, grape, 200
Leaf lettuce, *see* lettuce, 333–342
  varieties, 334
Leaf-roller, strawberry, 175
Leaf spot, bush-fruit, 229
  strawberry, 175
Leaves, importance, 6
  structure, 3, 24
  uses, 3
Leek, *see* onion, 293–300
Lettuce, 333–342
  analysis, 333
  beds, 336–337
  blanching, 339–340
  bulletins, 333
  cos, 335, 339
  cultivation, 338–340
  enemies, 340, 342
  fertilizing, 337–338
  grading, 341
  harvesting, 340–341
  head, 335
  jobs, 333
  labor, 333
  leaf, 336
  marketing, 341
  moisture, 338
  packing, 341
  plant beds, 336–337
  possibilities, 333
  references, 333
  seed, 336
  setting, 338
  shading, 338–339
  shifting, 337
  soil preparation, 337
  starting, 336–337
  success with, 333
  transplanting, 337–338
  varieties, 334–335
Library books, 457
Light for plants, 2
Lima beans, 275
  orchard needs, 54
Lime-sulfur,
  effects, 91
  formulas, 452
  making, 76–78
  scale spray, 83
Lime-sulfur—(*Continued*)
  using, 78–79
  vs. Bordeaux, 73
Liming, cabbage, cauliflower, 347
  strawberry, 164
  truck soil, 240
Lists, planting, 421–425
  annual flowers, 419, 421
  perennial flowers, 418
  shrubbery, 421–425
  vines, 421–425
Location, apple and pear, 39, 40
  bush-fruits, 216–217
  grape, 187–188
  strawberry, 156, 161–162
Loganberry, *see* bush-fruits, 207–232
Log, measuring, 400
Low vs. high heading, 47–48, 55
Lumber in logs, 400
Lumber trees, 378

M

Machine harvesters, peas, 368
Mahaleb cherry stocks, 118
Manuring strawberry, 163
Map,
  apple regions, 29
  bush-fruit, 209
  cherry, 111
  peach, 110
  pear regions, 29
  plum and prune, 111
  strawberry, 156
  vegetable seeds, 13
Maple sugar, 372
Marker, garden, 281
Marketing,
  apple and pear, 104–106
  asparagus, 313
  beets, other roots, 306–307
  bush-fruit, 232
  cabbage, cauliflower, 352–354
  celery, 332
  coöperative, 265–266
  grape, 204–206
  lettuce, 341
  melon, corn, bean, okra, 289–291
    steps in, 290
  mustard, spinach, 357
  onion, 300
  peach, plum, cherry, 151–154
  peas, 369
  rhubarb, 317–318
  roadside, 106

Marketing—(*Continued*)
  strawberry, 178–180
    difficulties, 179
  tomato, eggplant, pepper, 265–266
  truck vs. rail, 290–291
  vegetable, 233
  woodland, 400–403
Markets,
  apple and pear, 28
  asparagus, 309
  beets, other roots, 301
  neighborhood, 291
  peach, plum, cherry, 113
  rhubarb, 315–316
  school garden, 307
Marking, celery rows, 327
  fruit packages, 99, 102–103
Mattock tree planting, 388
Maturity, apple and pear, 97
Mazzard cherry stocks, 118
Measuring greens, 357
Mechanical graders, 150
Melon, corn, bean, okra, 269–292
  acreage, 277
  analysis, 269
  bulletin, 269
  capital, 270
  containers, 289
  cultivation, 282–284
  diseases, 287
    anthracnose, 287
    rust, 287
    wilt, 287
  enemies, 284–287
    bean weevil, 287
    borers, 286
    control of, 284
    cucumber beetles, 284
    earworm, 286
    lice, 285
    squash bug, 287
    white fly, 287
    worms, 287
  fertilizers, 280
  freshness, 291
  grading, 288–289
  harvesting, 288–289
  jobs, 269
  labor, 270
  marketing, 289–291
  markets, 271
  picking, 288
  planting, 280–282
  pollination, 283–284
  possibilities, 269–271
  prices, 270
  references, 269
Melon—(*Continued*)
  regions, 270
  seed, 277
    testing, 278
    treating, 279
  soil preparation, 279–280
  soils, 276, 277
  uses, 271, 291
  varieties, 272–276
  yields, 270
Mendel's law, fixation of, 21
  limits of, 21
  results of, 21
Mice, tree injury, 34
Mildews, grape, 199–200
Miscible oils, 82
Mixing sprays, 73–83
Moisture, growth, 1–2
  lettuce, 338
  saving, 283
Mound layering, 216
Mulching, strawberry, 172–174
Munson system, grape, 193
Muskmelon, *see* melon, 269–292
Mustard and spinach, 355–360
  analysis, 355
  bulletins, 355
  cultivation, 356
  demand for, 355
  fertilizing, 356
  harvesting, 357
  jobs, 355
  marketing, 357
  planting, 356
  possibilities, 355
  references, 355
  regions, 355
  seed, 356
  soil, 356
  soil preparation, 356
  varieties, 355–356
Mutation in plants, 18

N

Nematodes,
  beets, other roots, 306
  cabbage, 349
  grape, 186
New Zealand, spinach, 357
Niagara grapes, 183
Nicotine sprays, 82, 447, 449
  experiment, 24
  orchard effects, 52
Nozzles, fine vs. coarse, 90
  spray, 88–89

Nursery,
  care of grape, 185
  catalogs, 384, 433
  enemies, 34, 35
  forest, 382, 383
  inspection of, 34–35, 43, 124
  location, 42

O

Oil emulsions, 81–82
Okra, 269–292
  varieties, 276
Onions, 293–300
  acreage, 295
  analysis, 293
  bulletins, 293
  capital, 294
  climate, 293
  cultivation, 297–298
  curing, 299–300
  enemies, 298
  fertilizing, 296–297
  field, 295
  grading, 300
  harvesting, 299
  jobs, 293
  labor, 294
  marketing, 300
  planting, 297
  possibilities, 293
  production, 293
  profits, 293
  references, 293
  seed, 295
    testing, 295
    treating, 295
  sets, 296
  soil, 295
    preparation, 296–297
  storing, 300
  thinning, 297
  thrips, 298
  types, 294
  varieties, 294
  weeding, 298
Orchard,
  costs of peach, 112
  disk harrow, 51
  fillers, 44
  intercrops, 48–50, 128–132
  intervals, 44–45
  lime, 54
  locations, 39, 40
  moving trees to, 47
  planting, 44–48
  pruning, 133–138
Orchard—(*Continued*)
  renovation, 92–96
  soil preparation, 41
  tillage plan, 50
Orcharding books, 456
Organic mercury, treatment, 16–17
Oriental peach moth, 144
Ornamentals, buying, 432–434
  ordering, 433
  planting, 439
Osmosis experiment, 5, 23–24
Oxygen, for plants, 2
  from plants, 23
  how obtained, 2
Oyster-shell bark-louse, 71

P

Packing,
  apple and pear, 99–103
  bush-fruit, 231
  cabbage, cauliflower, 352
  celery, 331
  grape, 202–204
  house, apple, 100–101
  lettuce, 341
  peach, plum, cherry, 147–151
  peas, 369
  strawberry, 177
  table, 102
Paper blanching, 329, 330
Parsley, 359
Parsnips, *see* beet, 301–307
Peach,
  baskets, 149
  brown rot, 138, 139
  enterprise, 109–153
  leaf curl, 138, 139
  oriental moth, 144
  scab, 139
  shipping seasons, 153
  yellows, 139–140
Peach, plum, and cherry, 109–153
  air drainage, 122
  analysis, 109
  blossom season, 123–124
  bulletins, 109
  capital, 112, 113
  care of trees, 124
  cold storage, 152
  containers, 148–152
  coöperation, 152
  costs, 112
  cultivation, 128–131
  digging holes, 127
  diseases, 138–141
  distances, 127

Peach, plum, and cherry—(*Continued*)
elevation, 122
enemies, 141–144
aphis, 144
beetles, Japanese, 144
borers, peach tree, 142–143
curculio, plum, 141
dangers from, 114
oriental peach moth, 144
San José scale, 143
exposures, 113, 123
fertilizers, 132, 133
grading, 147–150
harrowing for, 126
harvesting, 147–152
heeling-in, 124, 125
intercropping, 131, 132
jobs, 109
June vs. August buds, 123–124
marketing, 151–153
markets, 113
packing, 147–150
plant food, 132, 133
planting, 127–128
popularity, 110
possibilities, 109–114
prices, 113
propagation, 114–118
protection, against frost, 145–147
pruning, 133–137
references, 109
regions, 110, 111
sales, f. o. b., 152
shipping, coöperative, 152
seasons, 153
sites, laying out, 127, 128
locating, 113, 122–123
soil preparation, 125–127
special sprays, 145
spray schedule, 145
spraying, 144, 145
terracing, 126–127
thinning, 138
tree buying, 123–124
care, 124
inspection, 124
using surplus fruit, 153
varieties, 118–122
water bodies, 123
Pear, *see* apple, 27–107
analysis, 27
enterprise, 27–106
psylla, 72
region map, 29
slug, 69
Peas, 361–370
analysis, 361
bulletins, 361
by-products, 369
canning, 368–369
capital, 362
cultivation, 366
diseases, 367
remedies for, 367
enemies, lice, 367
weevils, 367–368
feed crop, 369–370
fertilizing, 364
harvesting, 368
height, 362
inoculating, seed, 363–364
jobs, 361
labor, 362
marketing, 369
maturity, 368
packing, 369
planting, 364–365
possibilities, 361–362
references, 361
regions, 361–362
shipping, 369
soil preparation, 364
sugar, 362
trellising, 366–367
using, 369
varieties, 362
Pecan enemies, 391
Peony root, 436
Peppers, *see* tomato, 239–268
soils, 245
sweet, 244
varieties, 244
Persian insect powder, 83
Phoma fruit spot, 64
orchard, 52
Phylloxera, grape, 202
resistant stocks, 202
Picking,
apple and pear, 96–98
grapes, 203–204
melon, corn, bean, okra, 288
peas, 368
Pine,
blister rust, 389
seed-bearing, 395
white, 375
Planking soil, 255–256
Planning,
drives, 406–407, 411, 430–432
improvements, 407–414
principles, 410

Planning—(*Continued*)
  roads, 406–407, 411, 430–432
  walks, 406–407, 430–432
Plans, garden, 233–236
  laying out, 430–432
Plant,
  beds, celery, 325
    tomato, eggplant, pepper, 247–252
  breeding, 17–23
  enemies, freedom from, 3
  food, 6
    effects of, 23
    requirements of, 6, 133
    supply, 2
  growth, conditions, 1
  lice,
    bush-fruit, 226–227
    elms, 391
    mustard, 357
    strawberry, 175
    turnip, 305
    vegetable, 261
  life, introduction to, 1
  parts of, 4
  societies, 1
Planting,
  apple and pear, 44–48
  asparagus, 311
  beets, other roots, 304
  board, 47
  bush-fruit, 217, 219
  by colors, 433
  cabbage, 347
  celery, 327
  flowers, 417–421
  forest nursery, 383
  foundation, 408, 412
  hedges, 421
  large trees, 387
  lettuce, 338
  melon, corn, bean, okra, 280–282
  mustard, spinach, 356
  onion, 297
  ornamental, 433
  peach, plum, cherry, 127, 128
  peas, 364, 365
  plants, 44–46
  proper places, 431
  residential, 408
  rhubarb, 316
  seedling trees, 387
  shrubs, 439–440
  suiting building, 408, 412, 413
  table, 236, 237
  tomato, eggplant, pepper, 256
  tree distances, 387
Planting—(*Continued*)
    mixtures, 387
    seasons, 387
    seeds, 388
  trees, 417, 425
  vines, 416, 417
  vineyard, 187–188
  woodland, 386–388
Plants,
  asparagus, 310
  cabbage, 344–346
    hardening, 346
  strawberry, 159–161
  vegetable, 254
Plate-budding, 117
Plowing,
  apple and pear, 41
  depth for truck, 240
  tomato, eggplant, pepper, 240, 254
  tree-rows, 128
  vegetable soils, 240
Plum, curculio, 138, 141
  see also peach, 109–153
  types, 121, 122
  varieties, 121, 122
Poison formulas, 445–455
  sprays, 79
Poles, selling, 402
Pollen, carried, 10
Pollination,
  apple and pear, 27
  cross, 10
  insects, 10
  melon and cucumber, 283
  methods of, 9–10, 24
  underground, 10
  wind, 10
Posting, woodland, 393–394
Posts, woodland, 402
Potato beetles, 261
Powder sprayers, 86
Powdery mildew,
  bush-fruit, 229
  grape, 200
Prepotency, 19
Pressure, spraying, 90
Prices,
  bush-fruit, 208
  celery, 324
  melon, corn, bean, okra, 270
  peach, plum, cherry, 113
  strawberry, 157
  tomato, eggplant, pepper, 241
  vegetables, 263
Problems explained, v
  see each job

Profits, improvement, 407, 441
  onion, 293
Projects, improvement, 406, 407
  tomato, 255
  woodland, 372
Prong-budding, 117
Propagation, apple, 31–34
  bulbs and tubers, 435–437
  bush-fruit, 213–216
  forest tree, 382–383
  grape, 184–187
  ornamentals, 435–439
  peach, plum, cherry, 114–118
  stone fruits, 114–118
  strawberry, 159–161
  tree roots, 436
Pruning,
  apple and pear, 54–59
  bearing trees, 56
  before planting, 47, 127, 128
  before spraying, 55
  bush-fruit, 218–223
  cherries, 133–138
  good and bad, 56
  grape, 190–195
  large limbs, 58
  peach, plum, cherry, 133–137
  rules, 58
  shade tree, 390
  shears, 135, 193
  strawberry roots, 160
  tomato, 260
  tools, 133–135
  tree roots, 127–128
  winter, 55–58
  young orchard, 56
Publicity, improvements, 441–442
Pumpkins, 292
Pumps, spray, 85, 86
Purposes in horticulture, v
Pyrethrum insect powder, 83

R

Rabbits, traps for, 34, 35
Radish, 308
Rag-doll tester, 15
Railroad ties, 402
Raspberry,
  pruning, 221–222
  sawflies, 225
  see bush-fruits, 207–232
  tip layering, 214
  trellising, 222, 223
  varieties, 208–213
Record, keeping, 106–107
Red spiders, 225
References,
  apple and pear, 27
  asparagus, 309
  beets, other roots, 301
  bush-fruit, 207
  cabbage, cauliflower, 343
  celery, 323
  grape, 181
  improvement, 405
  lettuce, 333
  library, 457
  melon, corn, bean, okra, 269
  mustard, spinach, 355
  onion, 293
  peach, plum, cherry, 109
  peas, 361
  strawberry, 155
  tomato, eggplant, pepper, 239
  woodland, 371
Reforesting lands, 394–397
  planting seeds, 396
  protecting growth, 396
  seed bed, 395
  seedlings, 396
  sprouts, 395–396
Regional varieties, melons, 272
Regions,
  apple and pear, 28, 29
  asparagus, 309
  bush-fruit, 208
  cabbage, cauliflower, 343
  grape, 182
  melon, corn, bean, okra, 270
  mustard, spinach, 355
  peach, plum, cherry, 110, 111
  peas, 361
  strawberry, 156
Renovation, apple and pear, 92–96
  cleft-grafting, 93–94
  cultivation, 93
  fertilizing, 93
  orchard, 92
  replanting, 96
  spraying, 93
  steps in, 93
    pruning, 93
  strawberry, 176–177
  top working, 93–95
Replanting trees, 96
Residence, planting near, 408, 411–412
Resistance, apple disease, 37
Reversion in plants, 18
Rhubarb, 315–318
  analysis, 315
  capital, 315
  care, 317

Rhubarb—(*Continued*)
  climate, 315
  crowns, 316
  cultivation, 317
  harvesting, 317
  jobs, 315
  labor, 315
  market, 315
  marketing, 317–318
  planting, 316
  possibilities, 315
  seed bed, 316
  selection of, 316
  selling, 317
  soil, preparation, 316
Roads,
  bituminous, 432, 434
  concrete, 432, 434
  dirt, 432, 434
  planning, 432, 434
  staking, 432
Roadside markets, 106
Romaine, 335
Root, cuttings, blackberry, 213
  division, 216, 437–439
  gall, nursery trees, 141
  grafts, 32
  -hairs, work of, 5
  -knot, cabbage, 349
  uses of, 5
Root-knot, cabbage, 349
Rose, chafer, grape, 201
Rot,
  bitter, 62
    resistance to, 37
  black,
    cabbage, 350
    grape, 197
  brown, 138–139
  forest trees, 389
  pecans, hickories, 391
Rotations,
  melon, corn, bean, okra, 277
  summer vegetables, 277
  tomato, eggplant, pepper, 245
  tree harvest, 399
Rows, marking, 281
Runners, strawberry, 169–170
Rust, apple, 62–63
  cane, 228
  orange, 228
  pine blister, 230
  resistance, 37

S

Saddle-grafting, 33
Salad, corn, 360
Sales, f. o. b. tracks, 152
Sales records, 107
San José scale, 70–72, 83, 143, 226
Sap, maple, 372
Sauerkraut, 352, 353
Saving vegetable seed, 278
Sawflies, raspberry, 225
Saw-logs, 400, 401
Sawmills, temporary, 401
Scab, apple, 60
Scab, beets, other roots, 306
  peach, 139
  resistance, 37
Scale insects, 71
Schedule, spray, 87
School, garden class, 361
  market, 307
Scions, 30–35
Scurfy bark-louse, 71
Sea kale, 320
Season, apple, 38
Seasons, peach shipping, 153
Seed,
  asparagus, 310
  associations, 23, 24
  bed, reforesting, 395
  bed, rhubarb, 316
  vegetable crops, 279
Seed beds, forest tree, 382
  beets, other roots, 302–303
  breeders, 22, 23, 25
  buying vegetable, 277
  cabbage, cauliflower, 345
  celery, 324
  certified vegetable, 278
  onion, 295
  peas, 362
  pests, 12
  planting, trees, 388
  saving vegetable, 278
  soaking vegetable, 278
  sources, garden, 13
  stores, visits, 25
  testing vegetable, 278
  tomato, eggplant, pepper, 245–247
  treating vegetable, 278
Seedlings, forest, 382, 383
Seeds, age of, 15
  analysis, 15–16
  buying, 14, 16
  choice of, 24
  contest, 24
  forest tree, 382
  growth, 11
  improvement, 22, 25
  impurities, 16
  influence, 20

Seeds—(*Continued*)
  longevity, 14
  nourishment, 11
  pedigreed, 22
  production of, 8, 24
  propagation by, 7
  purposes, 7
  samples, 16
  saving, 12, 24
  selection, 12, 24
  storage, 12
  testing, 15
  treating, 16–17
  trial grounds, 13–14
  underground, 11
  weight, 25
Selection, careful, 19, 24
Self-boiled lime-sulfur, 78
Selling greens, 357
  rhubarb, 318
  saw-logs, 400
Sets, onion, 296
Setting, asparagus, 311
  cabbage plants, 347
  ornamentals, 433
  strawberries, 164–169
  tomato, eggplant, pepper, 256
  vineyard, 190
Shelter belt, preparing, 385
Shelter belts, 372
Shield-budding, 117
  grafting, 34
Shifting, lettuce, 337
  plants, hotbed, 257
Shipping dates, peach, 153
  peach, plum, cherry, 152
Shot-hole fungus, 140
Shrubs, kind to plant, 415, 421–422, 424
Side-grafting, 33
Sifting seeds, 23, 25
Site,
  apple and pear, 44–46
  orchard, 122–123
  strawberry, 161–162
  woodland, 379–381
Small fruits,
  books on, 457
Smudge pots, 147
Smudges, frost, 146
Soaking seeds, 247, 278
Soap sprays, 82
Soil, asparagus, 310, 311
  beets, other roots, 303
  bush-fruits, 208
    preparation of, 216–217
Soil—(*Continued*)
  cabbage, cauliflower, 346–348
    preparation of, 347
  celery, 326, 327
    acidity, 326
  drouthy, 276, 277
  grape, 182
  improving, 240
    grape, 187
    orchard, 125
  influences, 19
  lettuce, 337, 338
  melon, corn, bean, okra, 276, 277
  mustard, spinach, 356
  onion, 295
  peach, plum, cherry, 113
  peas, 364, 365
  preparation, apple and pear, 40, 41
    asparagus, 311
    hillsides, 386
    melon, corn, bean, okra, 279, 280
    onion, 296, 297
    peach, plum, cherry, 125, 126
    rocky fields, 386
    rhubarb, 316
    shelter belt, 385
    strawberry, 162–164
    stump lands, 386
    tomato, eggplant, pepper, 254–256
    woodland, 385
  rhubarb, 316
  selection, tomato, eggplant, pepper, 244, 245
  strawberry, 155–156
  tomato, eggplant, pepper, 240, 241
  warm, 281
Species, woodland, 374–380
Spinach, New Zealand, 357
  see mustard, 355–357
Spirea, clumps, 413
Splice-grafting, 33
Spray hose, 88
  materials, 73–83, 437–439
  nozzles, 88, 89
  rods, 88
  towers, 86, 88
Sprayer, air pressure, 226
  grape, 198
  types, 85–89
Spraying,
  apple and pear, 84–91
  effects, 74
  fillers, 46
  peach, plum, cherry, 144, 145
  poison, 79
  pressure, 90

Spraying—(*Continued*)
principles, 89
profits, 74, 91
purposes, 74
schedule, 87, 88
peach, 145
Sprouts, reforesting, 395
Spruce cones, 376, 377
Squash, 291
bugs, 286
intercrop, 130
Staking,
beds, 432
improvements, 432
raspberries, 222, 223
roads and walks, 432
terraces, 432
tomatoes, 258–260
Stem structures, 4
Stocks, cherry, 118
Stone fruits, *see* peach, 109–153
special sprays, 145
Storage, apple and pear, 98
apple temperature, 99
tomato seed, 246
Storing,
cabbage, cauliflower, 352
celery, 331
onion, 300
Strawberry, 155–180
air drainage, 162
analysis, 155
aphids, 174
blossom types, 158
bulletins, 155
commercial, 158
crushed, 180
cultivation, 169–172
diseases, 175
drouth protection, 163
enemies, 174–175
exposure, 162
fertilizing, 170, 172
field, 157
harvesting, 177–178
hedge row, 164–165
heeling-in, 161
hill-row system, 165–166
holding plants, 161
investment, 156
jobs, 155
labor, 156
leaf roller, 175
spot, 175
liming, 164
location, 156, 161–162
manuring, 163
Strawberry—(*Continued*)
market difficulties, 179
marketing, 178–180
matted row, 164
mulch removal, 173
mulching, 172–174
new varieties, 159
packing, 177–178
plants, 159–161
per acre, 166
possibilities, 155–157
prices, 157
propagation, 159–161
bed, 161
vs. buying, 161
references, 155
regions, 155–156
renovation, 176–177
resistant, 159
runner cutting, 170
setting, 169
shed for packing, 177–178
site, 161–162
soil preparation, 162–164
soils, 155, 162, 163
surplus, 180
system of setting, 164–169
using, 178–180
varieties, 157–159
weevil, 174
yields, 157
Striped cucumber beetles, 284
Suckers, propagation, 437
Sucking insects, 70–72
fighting, 83
Sugar—maple sap, 372
Suiting markets, 104
Sun scald, 62
Sunscald, trees, 394
Surplus fruit, using, 153
strawberries, 180
Survey, seed, 25
Survival, like and unlike, 18
Swampy woods, 381
Sweet corn, 269–292
varieties, 273
Swiss chard, 357–358

T

Table corn, 269–292
Tamarack woods, 378
Tank sprayers, 85, 86
Tax, woodland, 373
Temperature, growth, 1
Tender vegetables, 237

Tent caterpillars, 68, 391
Terraces, staking, 425
Terracing, orchard, 126
Testing,
  cabbage seed, 345
  celery seed, 324
  lettuce seed, 336
  onion seed, 295
  pea seed, 363
  seeds, 15
  vegetable seed, 246, 278
Thermometer, wet- and dry-bulb, 147
Thinning,
  fruit, 59
  onion, 297
  peach, plum, cherry, 137, 138
  woods growth, 396
Thrips, onion, 298
Tillage,
  cabbage, 348
  early garden, 283
  implements, 255–258
  late garden, 283
Tip burn, lettuce, 340
  layering, raspberry, 214
Tobacco dust, 83
Tomato,
  fruit worm, 260
  horn worm, 260
  project, 255
  smooth vs. grooved, 242
  wilt, 262
Tomato, eggplant, and pepper, 239–268
  acreage, 245
  analysis, 239
  bulletins, 239
  canneries, 266
  capital, 241
  containers, 264
  coöperation, 265
  cover crops, 240
  cultivation, 257–260
  distances, 256
  earliness vs. price, 263
  enemies, 260–262
  grading, 264
  harvesting, 263, 264
  insects, 260–261
  jobs, 239
  labor, 241
  marketing, 265–266
  maturity, 263–264
  organic matter, 240
  packing, 264
  plant beds, 247
  plants for sale, 253
Tomato, eggplant, and pepper—(*Continued*)
  possibilities, 239–241
  prices, 241, 263
  pruning, 267
  reference, 239
  regions, 240
  seed testing, 246
  seed treatment, 246–247
  selling, commission, 265
  size of field, 245
  soil preparation, 254–255
  soils, 240, 241, 245
  staking, 267
  transplanted, 253
  transplanting, 256–257
  varieties, 241–244
  yields, 241
Tongue-grafting, 31
Tools, garden, 305, 361
  pruning, 133–135, 191
Top-working trees, 93–95
Towers, spray, 86, 88
Transplanting,
  cabbage, cauliflower, 347
  lettuce, 337
  machine, 169
  tomato, eggplant, pepper, 256–257
  tree seedlings, 383
Treating,
  beet seed, 303
  cabbage seed, 345–346
  celery seed, 325
  lettuce seed, 336
  onion seed, 295
  vegetable seed, 247, 277
Trees,
  age to buy, 42, 384
  buying, 42–43, 384
  cuttings, 383
  digging holes, 127
  drouth, 380
  felling, 398
  from seed, 380
  grouping, 414
  holes, 439–440
  kinds to plant, 377, 417
  lumber, 378
  ordering, 384
  planting, 47
    crew, 128
    large, 387
  prices, 384
  pruning, 390
  rapid growth, 378
  receiving, 384
  seed-bearing, 395

Trees—(*Continued*)
seedlings, moving, 383
surgery, 390
wet land, 378
Trellising, bush-fruit, 222–223
grapes, 192–195
peas, 366
Trial grounds, seedsmen, 13–14
Trimming felled trees, 399
Truck vs. rail marketing, 290
Turnips, *see* beet, 301–308
Twig blight, 61

U

Underground blossoms, 11
Upland cress, 359
Using surplus, peach, plum, cherry, 153
vegetable surplus, 291

V

Variation, laws of, 17
sudden, 18, 25
Varieties,
apple and pear, 35–38
bean, 274
beets, other roots, 302
bush-fruit, 208–212
cabbage, cauliflower, 345
cantaloupe, 273
celery, 324
choosing apple, 36–38
cucumber, 273
grape, 182–184
home orchard, 36
lettuce, 334, 335
melon, corn, bean, okra, 271–276
mustard, spinach, 355
okra, 275, 276
onion, 294
peach, 119
peas, 362
regional, 272
resistant, 37
sour cherry, 120
strawberry, 157–159
summer apples, 104
sweet cherry, 120
table corn, 273
tomato, eggplant, pepper, 241–244
watermelon, 273
winter varieties, 105
woodland, 374–380
Vegetable,
books, 457
fertilizer, 280
Vegetable—(*Continued*)
frames, 254
freshness, 291
garden, home, 233–238
hardiness, 237
intercrops, 130
market, 233
seed, sources, 13
Veneer-grafting, 33
Vine,
annual, 416–417
borers, 286
kinds and places, 416
supports, 416
uses, 414–416
Vineyard, *see* grape, 181–206
Virus diseases, raspberry, 228

W

Walks, concrete, 440
edging, 440
planning, 431–432
staking, 432
Warm season vegetables, 269–292
soils, vegetables, 281
Warmth for growth, 1
Water influence, orchard, 123
Watering, tomato, eggplant, pepper, 251, 257
Watermelon, *see* melon, 269–292
varieties, 273
Wax, grafting, 34
Web worms, 391
Weeding, onion, 298
Weeds, killing garden, 283
Weevils,
bean, 287
pea, 267
strawberry, 174
Weighing, greens, 357
seeds, 23, 25
Wet- and dry-bulb thermometers, 147
Wheel, cultivator, 366
hoe, garden, 339
Whiptail, cauliflower, 350
White fly, bean, 287
pine rust, 230
Wilt,
cabbage, 349–350
resistant, tomato, 243
tomato, 262
Windbreaks, 372
locating, 381
Wind injury, woods, 394
pollination by, 10
Winter preparation, 7, 24

Wood structure, 4
Woodland, 371–403
  analysis, 371
  annual selling, 401
  bird life, 391
  bulletins, 371
  costs, 374
  crop methods, 397, 398
  enemies, 389–391
  fuel, 402
  harvesting, 397–399
  hillsides, 379–380
  jobs, 371
  marketing, 400–403
  maturity, 398
  needs, 373
  planting, 386–388
  possibilities, 371–374
  posting, 393
  posts, 402
  products, 372, 399
  projects, 372
  references, 371
  rocky fields, 379–380, 386
  seedlings, 382
  seed planting, 396
Woodland—(*Continued*)
  seeds, 382
  site, 374
  sites, 379–381
  species, 374–380
  time needed, 374
  tree felling, 398
  trimming products, 399
  wet, 381
  windbreaks, 372, 381, 403
  wind injury, 394
Woodlot, *see* woodland, 371–403
Woolly aphis, 72
Wrapping tomatoes, 264

Y

Yellows, cabbage, 349–350
Yields,
  bush-fruit, 209
  celery, 324
  melon, corn, bean, okra, 270
  peach, 112
  strawberry, 157
  tomato, eggplant, pepper, 241